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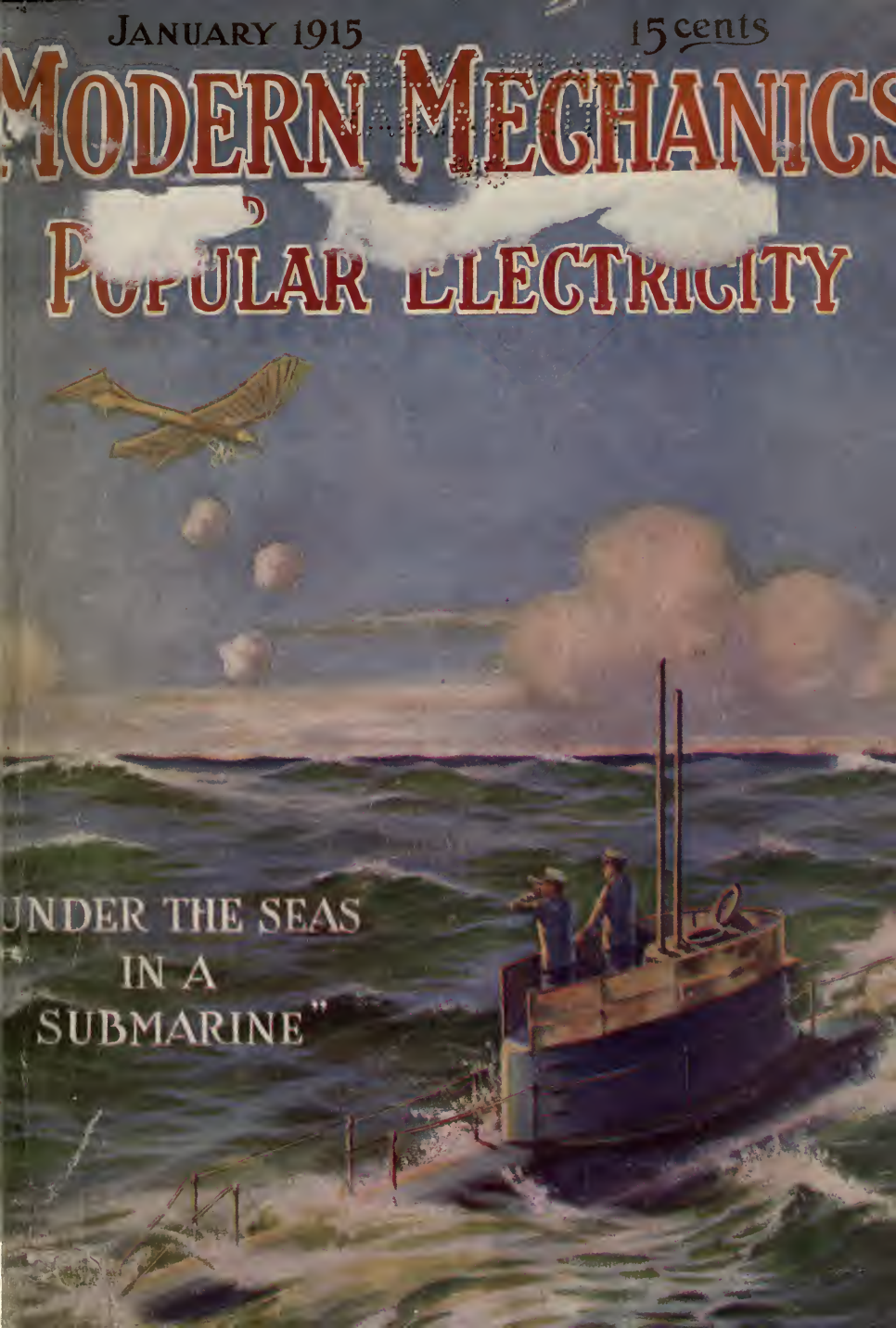

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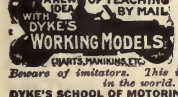

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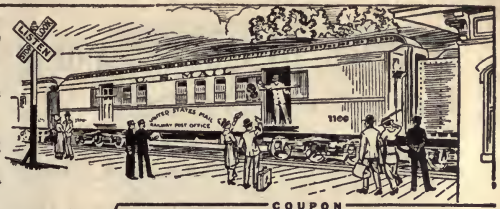

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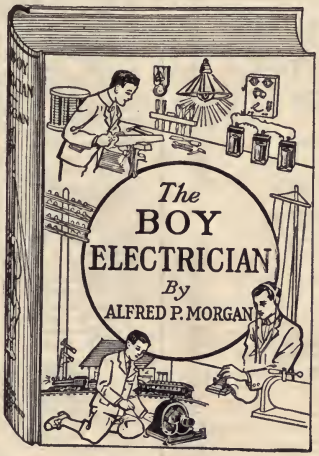

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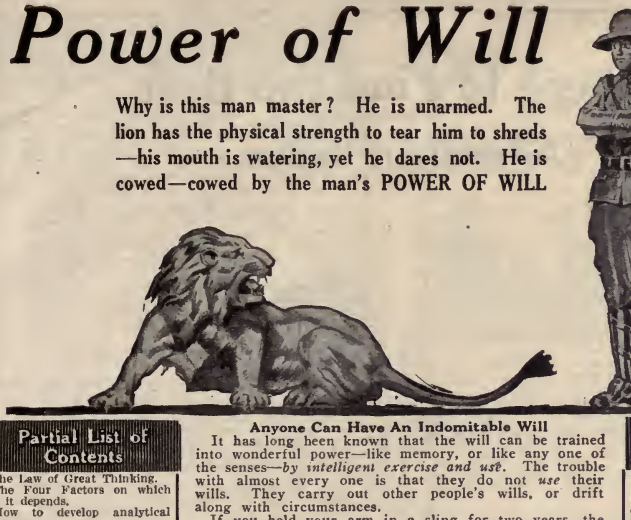

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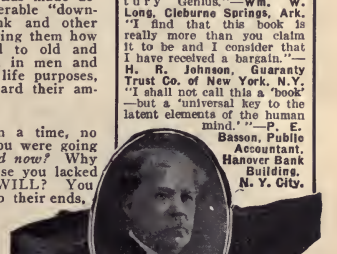

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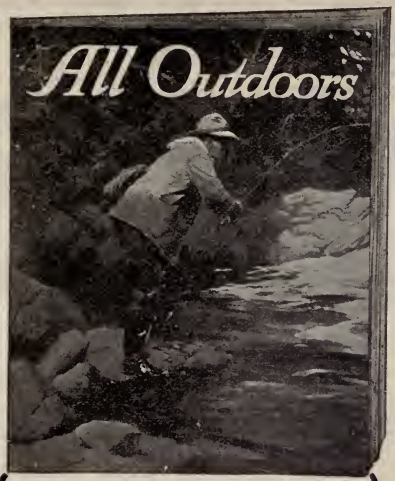

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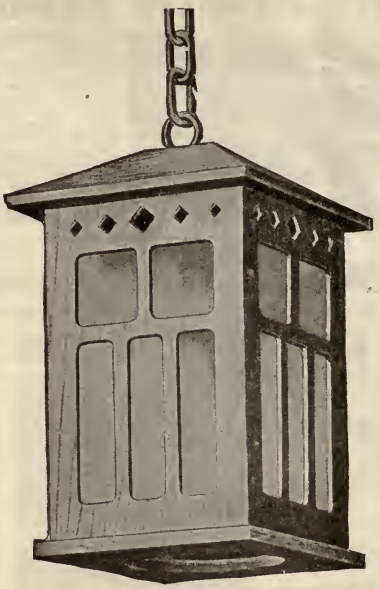

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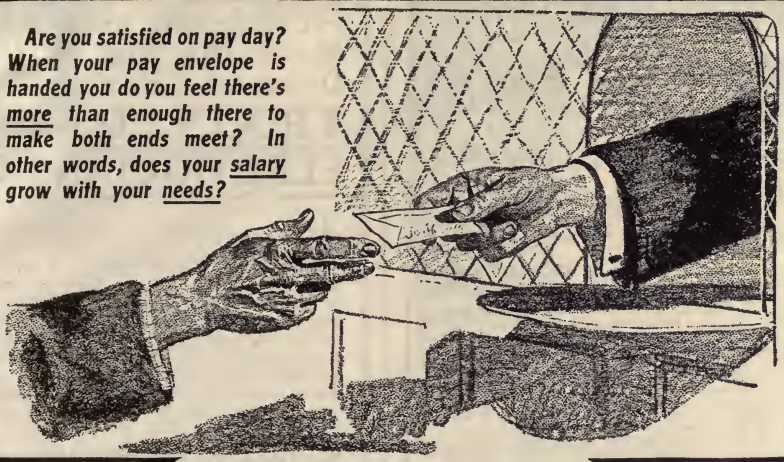

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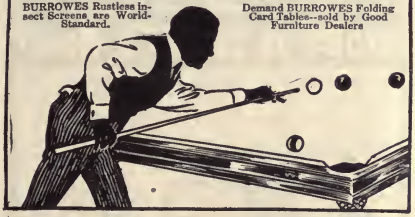

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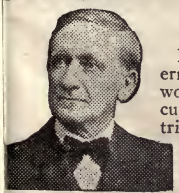

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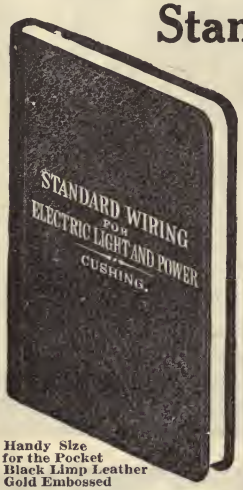

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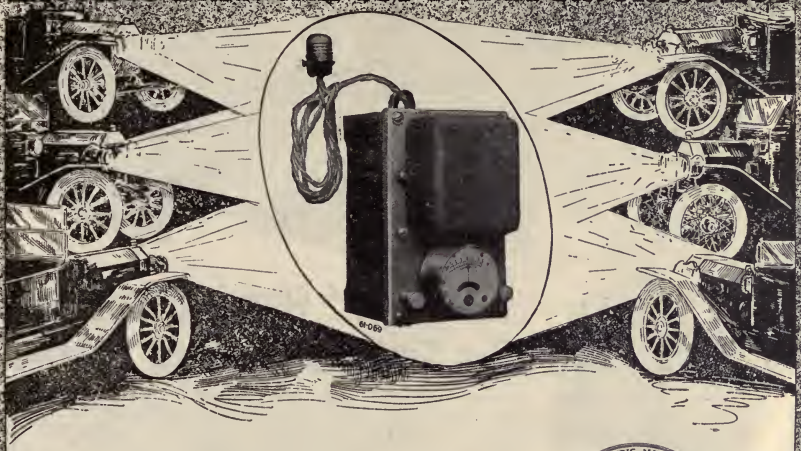

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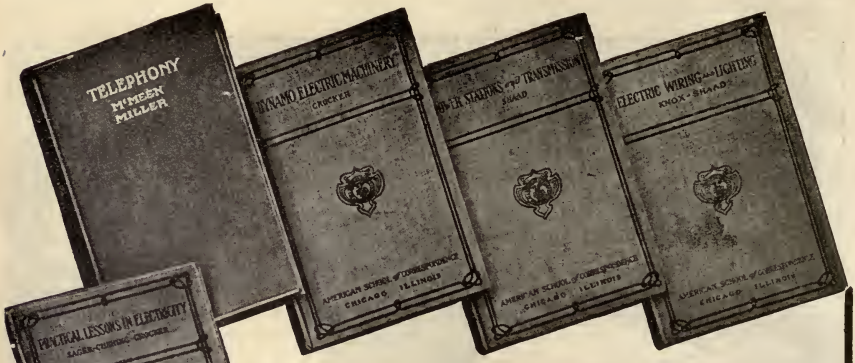

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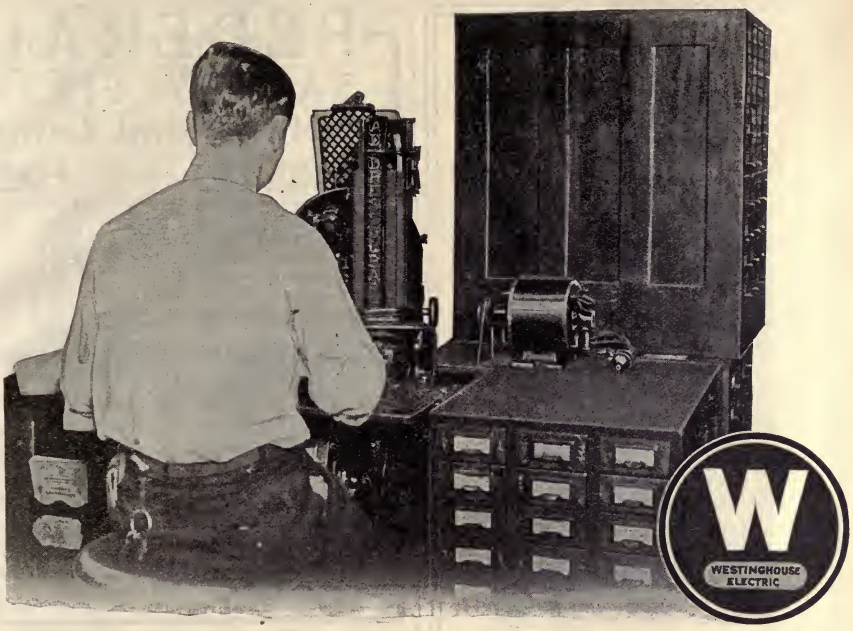

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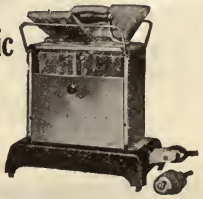

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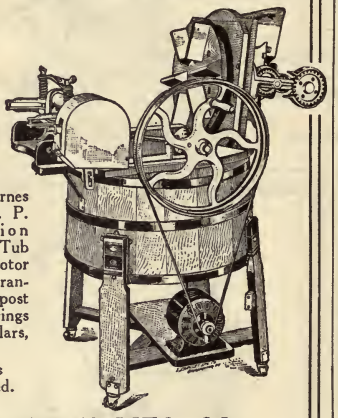

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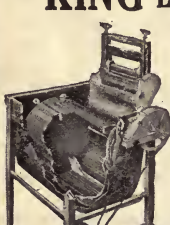

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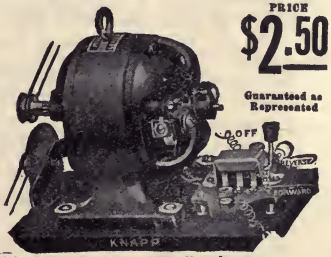

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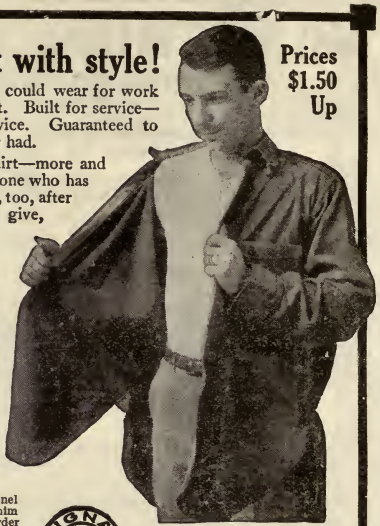

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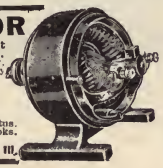

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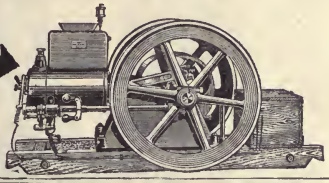

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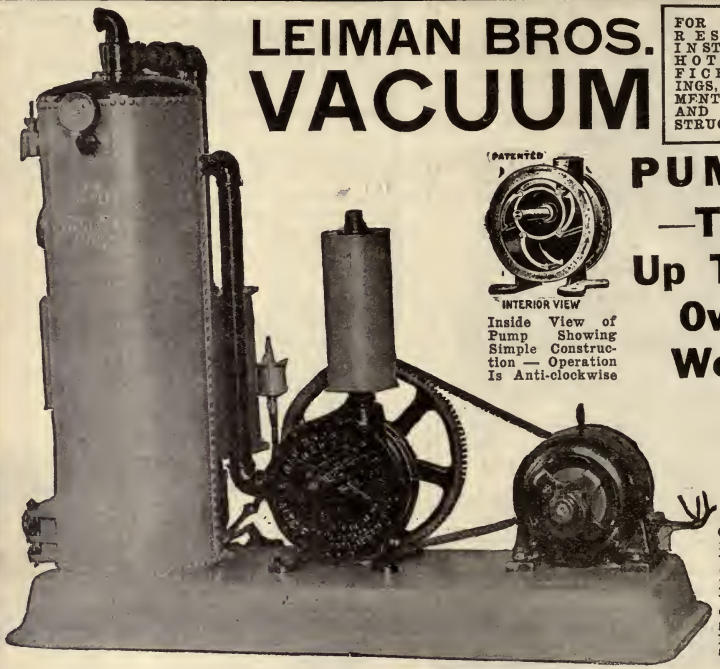

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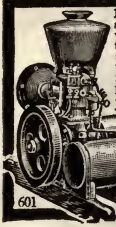

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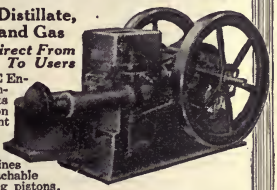

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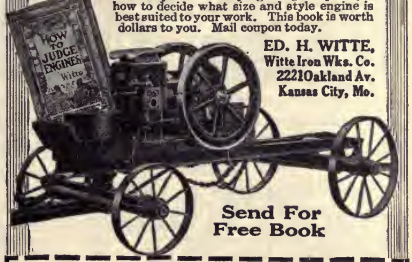

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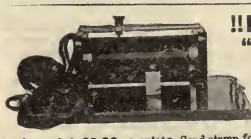

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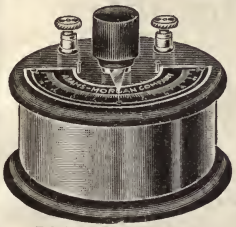

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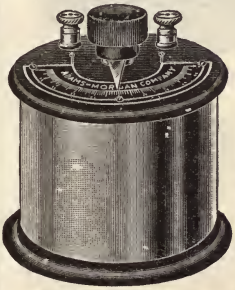

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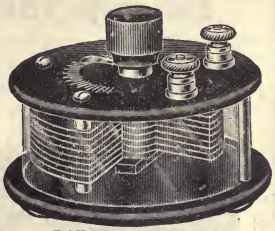

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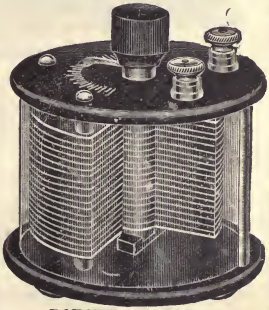

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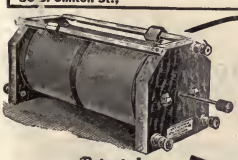


Patented.

Make Your Set More Efficient

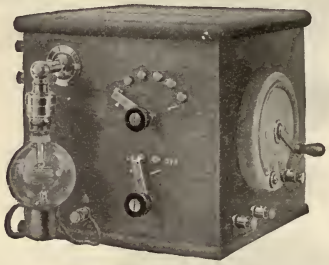
Howard L. Vail, M. D., of Dalton, Pa., writes in part: "The transformer is working fine. Scranton, Pa., only 13 miles away, never interferes. I could not ask for a better instrument." In order to advertise our unique instrument more extensively we are shipping our regular $10.00 transformer for only $5.00 during month of December. Send 2 cent stamp for literature.

COLBY'S TELEGRAPH SCHOOL, :: Auburn, N. Y.

DeFOREST AUDION DETECTORS

Incomparably Superior to Any Other Known Type

Type RJ4 Audion Detector



Type RJ5 Audion Detector

If you desire long distance reception of messages, you must have an Audion Detector. Tests of the Bureau of Standards show it to be the most sensitive and reliable detector ever invented. It stays in adjustment even where a transmitting set is used, and can be depended upon, absolutely, at all times.

The above types are regularly furnished with regular, or "S" grade, tantalum filament Audion Bulbs. Fitted with other grade bulbs at the difference of price of bulbs as listed below. A 4-volt storage battery or three dry cells are needed to light the filaments of the detectors, but are not furnished at these prices.

Bulbs are sold only for purposes of renewal, and then only upon return of the old bulb.

Price List, F. O. B. New York

Type RJ4 Audion Detector, with regular "S" grade bulb.....$18.00 net
Type RJ5 Audion Detector, with regular "S" grade bulb..... 25.00 net

Renewal Bulbs

Type "S" Regular Grade Audion Bulb (Tantalum Filament).....$3.50 net
Type "X" Extra Sensitive Audion Bulb (Tantalum Filament)..... 5.00 net
Type "S" Regular Grade Audion Bulb (Hudson Filament)..... 5.00 net
Type "X" Extra Sensitive Audion Bulb (Hudson Filament)..... 7.50 net

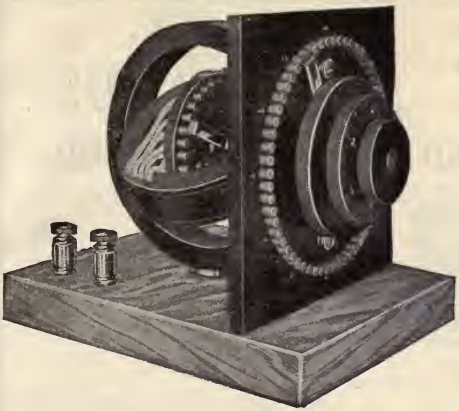
Hudson Filament Bulbs have a very long life, between 800 and 1,000 operating hours, which is about three times the life of tantalum filament bulbs.

All reliable wireless dealers handle Audion Detectors and renewal Bulbs. If you do not know your local dealer, we will give you his name.

For further information, see your dealer, or write us.

DeForest Radio Telephone & Telegraph Co.

101 PARK AVE. NEW YORK



Type D Tuner De Luxe

In offering our product we seldom talk price; we prefer to talk quality; but, the reduction in price of our Type D Receiving Transformer from $55.00 to $25.00 merits your consideration. The primary is varied by a sixty point switch, secondary thirty point switch, both of edgewise instrument type. Windings are of silk covered wire in slotted hard rubber rings mounted on a marble base. This is an instrument to which we are proud to attach the name Clapp-Eastham Co.

A New Catalog of

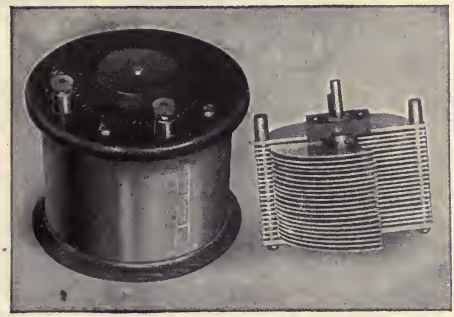
Clapp-Eastham Apparatus

Our new catalog just from the press shows an unusually large number of changes, improvements and additions to our line as well as a number of important price reductions without change of quality. Send 4c stamps for your copy to-day.

CLAPP-EASTHAM CO.

143 Main Street **CAMBRIDGE, MASS.**

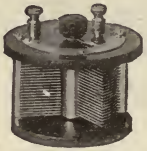
New Blitzen Rotary Variable Condenser



Capacity .001 M.F.—43 plates of genuine aluminum; metal shaft of highest grade tool steel; separators are machined to an accuracy of .0005 inch. The top and knob are moulded from a special insulating material which *will not lose* its high polish or color. Binding posts are of the same material and the case is of the clearest and toughest flint glass mounted on an aluminum base giving a beautiful finish to the instrument and allowing the operating parts to be seen at all times. Remember we manufactured and marketed the first rotary variable condenser in this country. Price $4.00.

MURDOCK APPARATUS

CONSISTENTLY AND PERMANENTLY GOOD

$4.00  $4.00

(EXTERIOR) (INTERIOR)

Variable Condenser No. 366

The best variable condenser ever made for amateur use, offered at a price so low that every owner of an amateur station can afford to add this remarkably handsome and efficient instrument to his receiving set. It has a capacity of more than .001 mfd. It has 43 plates. It has a polished composition case with scale and indicator. It has every refinement which contributes to excellent appearance and superior operation. It rivals in looks and in sensitive precision the best professional apparatus. It surpasses in constructional detail and radio efficiency any amateur instrument ever manufactured. It is a perfect example of the sensitive, substantial apparatus which has made the MURDOCK product the standard by which amateur operators invariably judge.

The Murdock nameplate on any instrument is a symbol of satisfactory service. The combination of the Murdock nameplate on Condenser 366 and the rockbottom $4 price, compels the careful consideration of every wise amateur. Send the price TODAY. Say "Let me try V.C. 366." If by any chance you cannot agree that it is the best bargain you ever obtained, ship it back, and get your money.

A 48 page catalog, telling the whole story of the most complete line of fine amateur apparatus, will be sent upon request to those interested in really good instruments.

WM. J. MURDOCK COMPANY

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CHELSEA, - - MASS.
680 Howard Street, - - San Francisco

Murdock Apparatus sold by
J. J. DUCK CO.,
432 St. Clair Street, Toledo, Ohio

BRANDES RADIO RECEIVERS

Many of the head sets sold for wireless are merely high-wound telephones.

Brandes' Receivers are designed and sold for use as wireless receivers only.

Send stamp for our New Catalogue—Just Out.

C. BRANDES, Inc., Wireless Receiver Specialists

7 Liberty Street, NEW YORK

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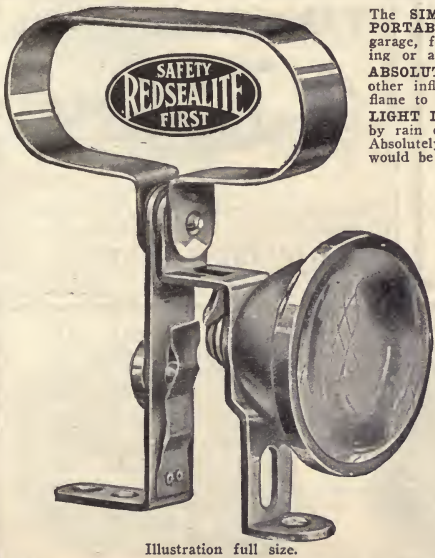

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The **SIMPLEST, MOST ECONOMICAL** and **RELIABLE PORTABLE** electric light made, for the home, factory, garage, farm; on the automobile, motor boat; when camping or any occasion where an artificial light is required.

ABSOLUTELY SAFE—Can be thrown into hay, straw or other inflammable material without danger, as there is no flame to ignite or heat to generate combustion.

LIGHT IS CLEAR, BRIGHT and **STEADY.** Not affected by rain or snow. The strongest gale cannot blow it out. Absolutely reliable where a candle, oil lamp or lantern would be valueless.

Economical in the use of current. The RED SEAL DRY BATTERY will give approximately 50 hours of intermittent service. Every up-to-date electrical house, garage or hardware store carries the RED SEAL DRY BATTERY—which does not deteriorate when not in use.

It is made of brass, nickel plated with tungsten miniature lamp, reflector and lens. Extremely simple in construction and will fit any standard size battery, so if the Red Seal Dry Battery cannot be had, other dry batteries will answer. EVERYONE NEEDS A REDSEALITE occasionally and many constantly. Get one. It is an absolute necessity. Once you appreciate its value you will never be without one.

No. 5337 Redsealite complete with battery $1.00

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TYPE K2

For Ordinary Wave Lengths, 200 to 1500 Meters

A loose coupler of standard design, wound with silk-covered wire, primary fitted with a roller contact (silver wheel) and secondary fitted with the regulation type of end switch.

Finished in mahogany, hard rubber and nickel.

We supply nothing cheap in quality and this instrument is no exception.

Price $5.00

TYPE G3

For Very Long Wave Lengths, 1000 to 17000 Meters

For receiving the new High Power Stations now testing.

The last word in efficient receiver design.

Type G3—Price $50.00

NOTE: Two $15.00 models, one with a range of 1000 to 8000 meters, and one with a range of 7000 to 17000 meters, will be ready Dec. 20th.

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Increase your effective radius

This Transformer gets the power out of a small condenser

Imagine what your sending set would do on 13200 volts. Your signals would carry to operators you never reached before. You would get *results* and pleasure not possible with a low voltage transformer.

This 13200 volt transformer has a capacity of ½ K.W., has 80000 turns of wire and four changes of power. Complete transformer set up in paraffine filled case $15.00. Unmounted transformer only $9.00.

You can't beat it. Write for circular.

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10 In. x 3½ In. Green Silk Tuning Coil, Double Slide	1.75
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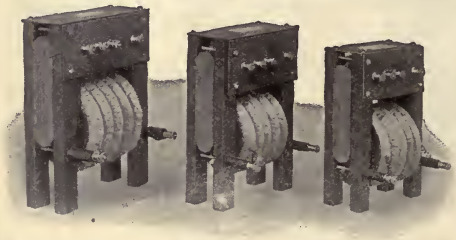
THE "Albany" Combination Detector

$2.00 Postpaid

Have you received our descriptive circulars? If not let us send them to you.

MAGUIRE & SHOTTON
814 Lancaster St., Albany, N. Y.



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TRANSFORMERS

1/4 K.W., 14000 volts,	$10.75
1/2 " " "	15.90
3/4 " " "	20.50

Same Transformers without special standard and casing, $9.00; $14.00 and $18.50 respectively

Send 2c stamp for our WIRELESS Supply catalogue and folders

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For our Mutual Advantage mention Modern Mechanics when writing to Advertisers.

"Boy Scouts' Wireless Outfit." Guaranteed to send from 1-6 miles. Has 1 in. spark coil, Key, sending Condenser, spark gap. Size 6 x 7½ x 14 ins. Weight 9 lbs. Price . . . **$5.95**

"Interstate Wireless" Receiving Outfit. Receives messages 300 miles. Has tuning coil, detector, telephone receiver, condenser, size 9 x 6 x 6 ins. Weight 4 lbs. Price **$3.70**

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Wireless Detector. Guaranteed to receive long distance messages with our $0.39 telephone receiver, or money back. Our Cyclopedia sent FREE with it. Price PREPAID **$0.10**

Bull Dog Spark Coils. Give Hot Spark. Fine finish. Perform 1000 experiments. Great for Wireless. ¼ in. Spark $1.98, ½ in. Spark $2.98, 1 in. Spark $3.98. Weights 4, 5, 6 lbs. Guaranteed 1 year.

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Send today 3 cents postage for a copy of our famous Electrical Cyclopedia No. 14, containing 400 illustrations, 1,600 articles. *"Treatise on Wireless Telegraphy"* and 20 coupons for free Wireless Course, also copy of Magazine "The Electrical Experimenter". With Detector, books free.

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Hustler Motor. Runs on 1 dry cell. Size 3 x 3 x 4 ins. Weight 1 lb **$0.83** Price . . . **$0.83**

Static Machine. Turning crank gives powerful 3 in. spark. No batteries required. Made of steel and hard rubber. Performs 500 experiments. Size 8 x 5 x 10 ins. Weight 6 lbs. **$3.70** Price . . . **$3.70**

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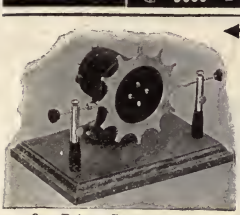
Dynamo. Very powerful. Gives 6 Volts, 6 Amperes. Lights 12 tungsten lamps, charges storage cells, runs as power motor. NOT A TOY. Size 6 x 6 x 6 ins. Weight 7 lbs. **$3.63** Price . . . **$3.63**



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Our Rotary Gaps have made a decided hit. No Wireless Station complete without one. No wabbling, run very steady, and on 60 cycles give a tone similar to a flute; run on 110 D. C. or A. C. Suitable for ¼ to 1 K. W. Motors have ¼" shafts. Two different H. P. Mahogany Bases, $11.50 and $12.50; Marble Bases, $12.50 and $13.50. Full details in Catalog. Send 5c in stamps for New Illustrated Catalog B-24. Positively none otherwise.

F. B. CHAMBERS & CO., 2046 Arch St., Phila., Pa.

JUST OUT

OUR NEW

Transmitting Sets for the Amateur

Complete set mounted on a finely finished cabinet comprising transformer, condenser, rotary spark gap, oscillation transformer, connected ready to use, designed to comply with the requirements of the Federal law. Made in ¼, ½ and 1 k.w. sizes. Our bulletin illustrating and describing these sets and parts of same sent anywhere on request.

The Wireless Mfg. Co., Canton, Ohio

Finished in Early English Oak or Mahogany

At Last! A Fixed Detector

—The most recent discovery in wireless fields; it cannot even be *jarred* out of adjustment. This means that all your messages will be received complete. ¶ Moreover, it is the most sensitive detector on the market—*bar none*—strongly made and should last a lifetime.

PRICE $20.00

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237 Greenwich Street, New York City

Discounts to the trade

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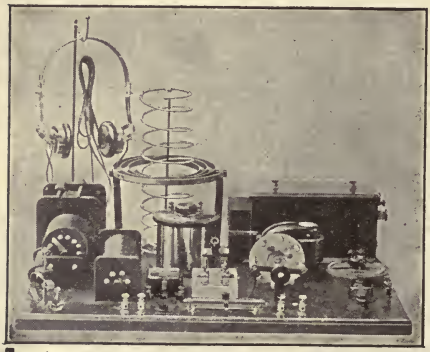
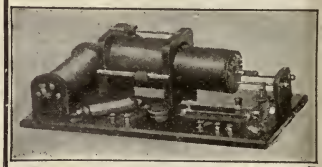
1/2 KILOWATT COMMERCIAL STATION $46.95



Receives up to 2600 miles. Sends up to 60 miles. Consists of ½ kilowatt vibrator transformer, Rotary Spark Gap, new type oscillation transformer, variable condenser, loose coupler and loading coil—tunes up to 3300 meters — detector, buzzer test and potentiometer. Complete in every detail ready to work.

Receive the Time from Arlington and all newspaper and ship reports.

OUR SPECIAL TIME SIGNAL RECEIVING OUTFIT. PRICE ONLY - - - $10.85



Complete in every detail. Tunes up to 3200 meters.

Complete Receiving Stations from $1.85 up.

Complete sending and receiving sets, $5.95 up.

Send Stamps for Bulletin "D. 40."

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NICHOLS ELECTRIC CO.
THE HOUSE FOR REMARKABLE VALUES

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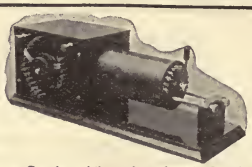
$15.00  **$15.00**

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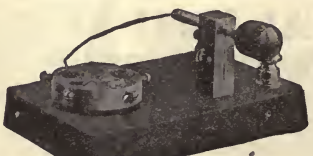
Navy Type Commercial Receiver

The many distinctive features of "Radio" apparatus positively command your attention. Our Audion receiving set shown above represents the latest design in delicate receiving circuits, whose degree of selectivity has never before been attained.

If interested in really efficient Radio apparatus send 5c in coin, for our catalogue; we issue new editions to it frequently.

THE RADIO APPARATUS CO.,
POTTSTOWN, PENNA., U. S. A.



New Halcun Detector

Holds five separate crystals, Cat Whisker Type, molded composition rubber base, nickel plated.

PRICES

With receiving condenser in base - - - - - - - $2.50
Without receiving condenser in base - - - - - - $2.00

HALLER-CUNNINGHAM ELECTRIC CO.
428 MARKET STREET San Francisco, California

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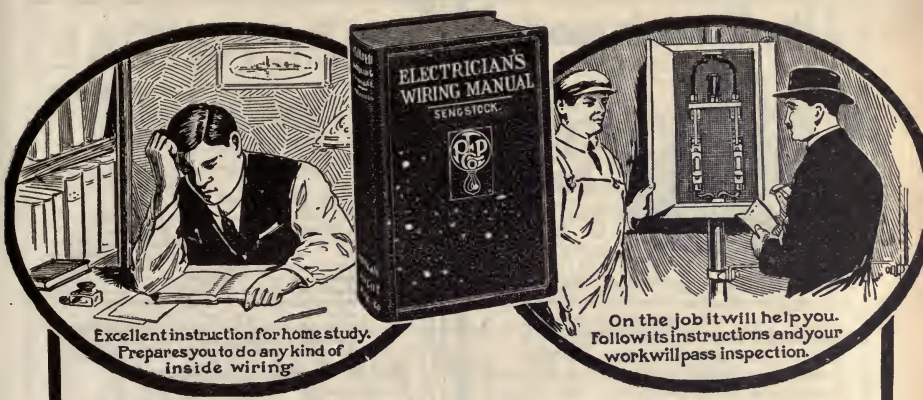

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When you're up against a stiff job, here's the book you want to tell you exactly what to do, and how to do it in strict accordance with the National Electrical Code. In a simple, compact form, it fully covers light and power installations.

Electrician's Wiring Manual

By* F. F. SENGSTOCK, *Electrical Inspector Chicago Board of Underwriters

The book that thousands of Wiremen, Contractors and Electricians have been waiting for. Not merely a discussion on Code rules. But straight talk by a man who knows the game from A to Z and gives you the benefit of his many years' experience. Shows you just how to proceed so that your work will pass the most exacting inspector. Every step explained in detail, made clear by 415 careful drawings. A chapter of practical kinks —tricks of the trade unknown to most wiremen—representing the experience of hundreds of practical workers, is alone worth the price of the book.

Twenty-Seven Chapters, 410 Pages, 415 Illustrations of Sound Practical Information, Flexible Leather Binding, Pocket Size

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I enclose $1.50, for which send me the "Electricians' Wiring Manual" as advertised.

It is understood that same may be returned within 10 days, if not satisfactory, and money will be refunded.

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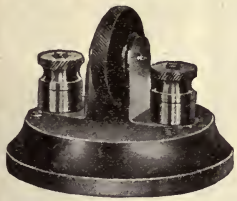
City..... State.....

3 New Wireless Instruments 3



The Crystaloi Detector

This wonderful little Detector is the height of mechanical and electrical achievement and will simply astonish you in its performance. It will not burn out or go dead, will last indefinitely and is the **MOST SENSITIVE** and practical Detector ever designed. All elements are sealed in the little cylinder which is rotated to secure finest adjustment. You can hear signals with this Detector that you never heard before. Write for full information.

Price $3.50. No postage

Constant Amplitude Test Buzzer

This is an ideal Buzzer for wireless work. It is provided with a lenient back-check which prevents the armature from overreaching. Has pure silver contact points—and is enclosed in a non-resonant composition case with three binding posts.

Price 75 cents. Postage 10 cents

Test Circuit Resonator

When installed in the Buzzer circuit this instrument has the ability to augment the sound in the ear phones six times their normal test audibility, and causes the crystal of any Detector to become extremely sensitive. It is wonderful when used with the CRYSTALOI. Full information on request.

Price $2.00. Postage 10 cents

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By T. O'Conor Sloane. The object of "Electricity Simplified" is to make the subject as plain as possible, and to show what the modern conception of electricity is: to show how two plates of different metals immersed in acid can send a message around the globe; to explain how a bundle of copper wire rotated by a steam engine can be the agent in lighting our streets; to tell what the volt, ohm, and ampere are, and what high and low tension mean; and to answer the questions that perpetually arise in the mind in this age of electricity. 158 pages. Price, $1.00.

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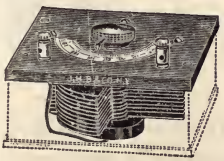

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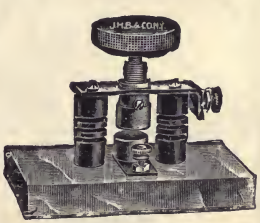

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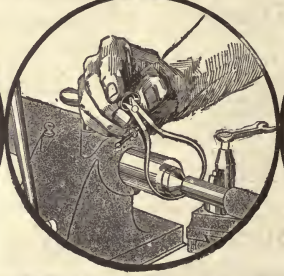

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Here is a new hand drill designed to do a better job in quicker time with less effort and less trouble and fulfilling each purpose perfectly.

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It is provided with a simple and effective ratchet, located on the crank handle, which is of great convenience when working in cramped corners or on a delicate job. The handle is detachable and hollowed for holding twist drills up to the largest size within the capacity of the chuck. The chuck is of the famous STAR three jaw pattern closing evenly on, and centering accurately, round shunks from 0 to ¼ inch in diameter. Jaw springs are protected from injury.

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Send for pocket catalog showing complete line.

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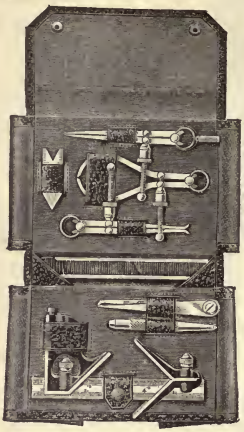

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If interested in other mechanics' tools send for free catalogue No. 25

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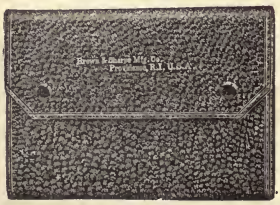
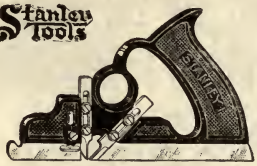


Stanley Tools



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Right-hand, left-hand and plain drill; and gears locked:

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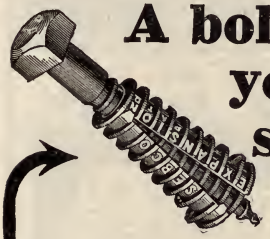

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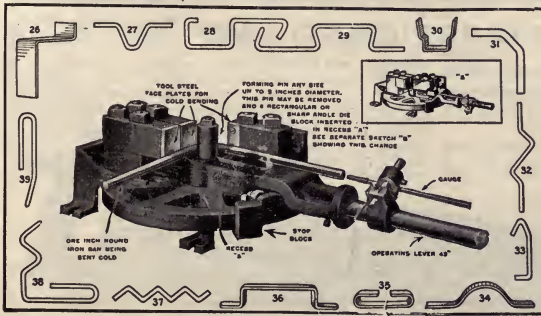

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It runs with more freedom and ease than the ordinary saw—with great speed and trueness.

For finishing almost any kind of work, for quick cutting any kind of dry wood, you need this saw, no matter how many saws you now own.

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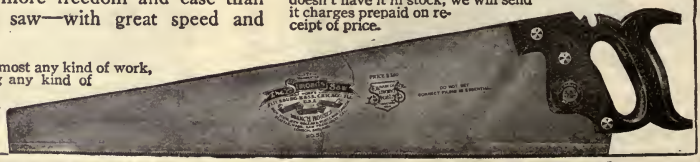

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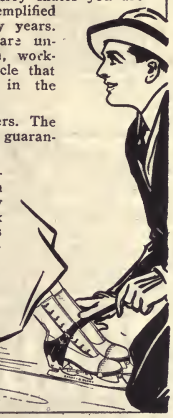

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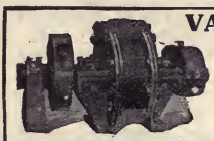
Cost Less - Last Longer than Wood Boats



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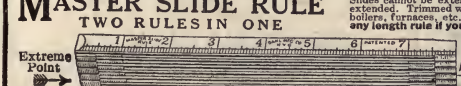
IMPROVED Interlocking—Rust-Proof—Fool-Proof

MASTER SLIDE RULE

TWO RULES IN ONE



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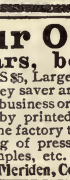

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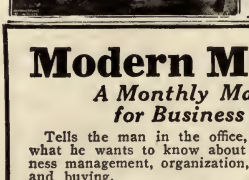

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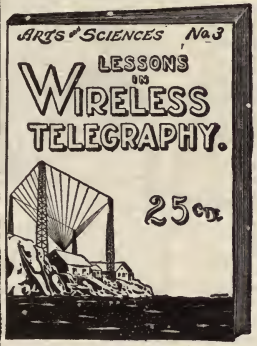

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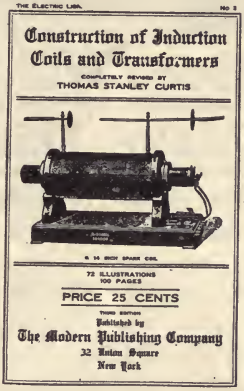

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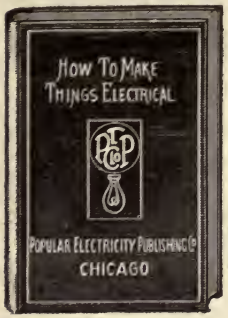

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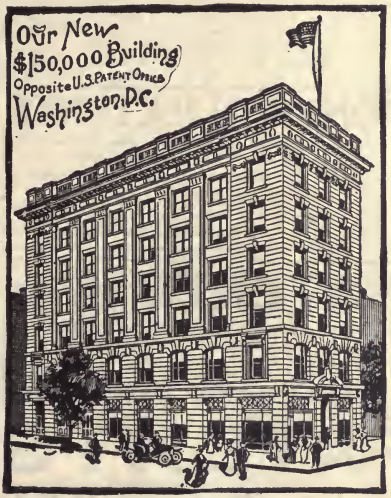

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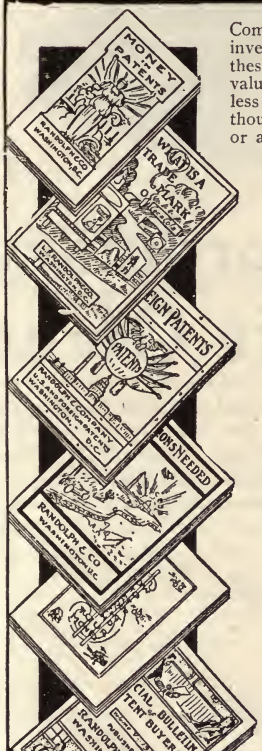

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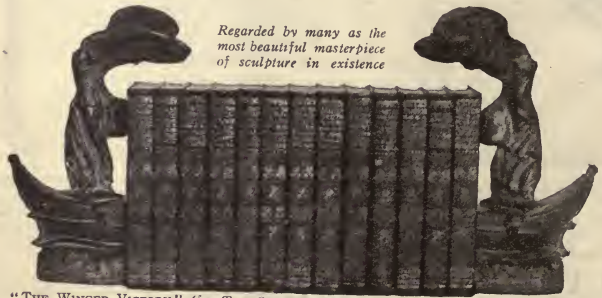

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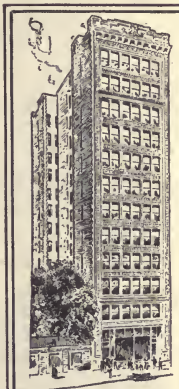

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MODERN MECHANICS In Plain English

Vol. 30 JANUARY, 1915 No. 1

ANNOUNCEMENT

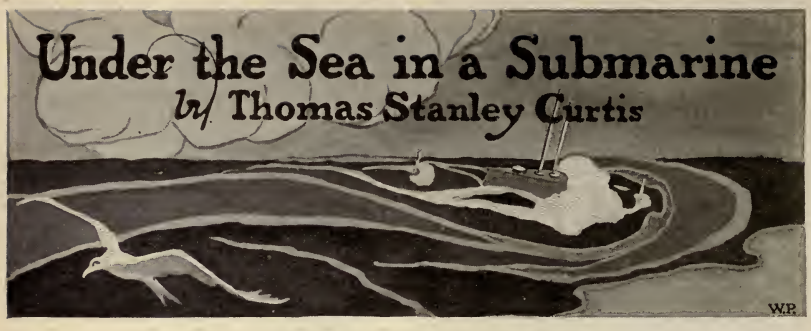
WITH the present issue, this magazine makes its initial bow to the public under its new name, MODERN MECHANICS.

The publishers have realized for some time that the former name of "Popular Electricity and Modern Mechanics" was so long as to be unwieldly and difficult of pronunciation; hence the change. The first half of the former title is carried on the cover only of this issue in order that readers may become accustomed to the new name.

The editorial policy of the past few months will be extended into the future and the aim will be to offer the readers bright, snappy accounts of all that is new and interesting in the field of electricity, wireless, mechanics and science. The popular, highly illustrated portion comprises the first half of the editorial section, while the remainder of the magazine is devoted to practical, "how-to-make" and "how-to-do" hints of inestimable value to the handy man about the house, the electrician, the mechanic and the serious investigator.

The Editors.

December 15th, 1914.

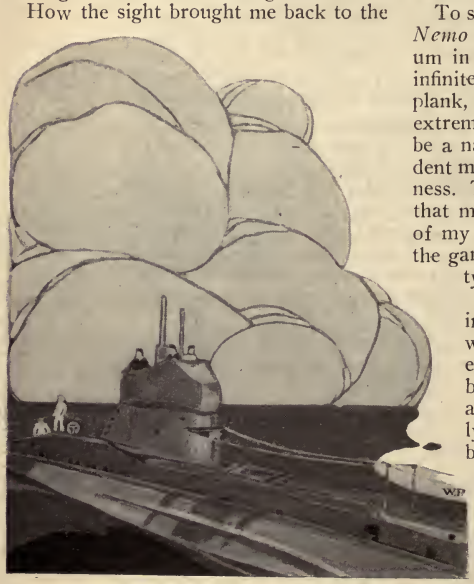


Illustrations by Waller Parker.

A tiny cockle shell of steel, manned by a handful of intrepid men; its approach unseen, unheralded; its hidden arm striking a blow that crumples the mighty dreadnaught as if of paper; such is the submarine in modern warfare. But is this wonder-craft confined, in its field of usefulness, solely to the destruction of life and property? In this story, a "landlubber" tells of the impressions received during his first and only trip on board a submarine vessel and incidentally suggests that the dream of the immortal Jules Verne is soon to be realized.

RISING above the waves, two slender tubes, each with an eye in its extremity like the lantern optic of some deep-sea fish, followed by an elongated deck-like superstructure and finally the shining whaleback of shining steel—

How the sight brought me back to the boyhood days when, with my beloved volume of "Twenty Thousand Leagues Under the Seas" I would follow, with tense nerves, the exploits of the intrepid *Captain Nemo* in his wonderful submarine vessel *The Nautilus*.



To say that I felt like a second *Captain Nemo* as I practiced a feat of equilibrium in crossing that piece of lumber of infinitesimal width, known as a gangplank, would be to handle the truth with extreme carelessness and, as this is to be a narrative of impressions, each incident must needs be related with all frankness. Therefore truth compels me to say that most of my dignity and not a little of my courage slipped over the sides of the gangplank during that walk of twenty feet from the wharf to the craft.

As the fiction writers say "It was in the cold, gray dawn of an early winter morning." It was cold right enough and horribly early—just before sunrise, in fact — and, as for the color tone, gray aptly describes it; gray sky, grayish-black water, gray wharf and the sinister-appearing fighting machine in dull gray, on which I had been so anxious to travel. I say "had been," for the first misgivings arose within me when I

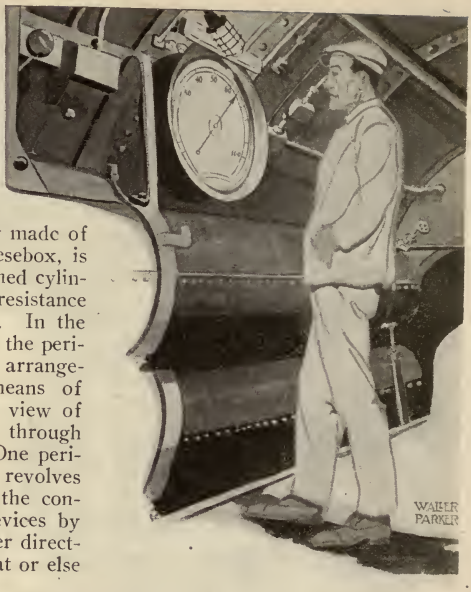
started across that swaying gangplank (also of gray). Arriving on deck my host, in command of the submarine, attempted to counteract the effects of the gangplank incident by assuring me that I might never again reach *terra firma,* once I had started in to investigate the mysteries of submarine navigation. Perhaps he was not so brutally frank in his mode of expression as I have been—but it made little difference. I'd have taken a chance with most anything rather than go back over that gangplank.

This cheerful little formality over with, I was escorted "below" via an iron ladder and through an opening which resembled the familiar manhole of our streets. Entering the operating chamber at the base of the ladder, an impression was formed which lasted throughout the entire tour of inspection; the interior of the craft presents a positively bewildering array of control levers, wheels, gauges, meters, and machines of almost every conceivable form. In fact, the craft as a whole is one compact mass of machinery—a veritable engine in itself.

Space will not permit of a detailed description of each individual department of the boat as I saw it and a general explanation in the words of the commander prior to our examination of the craft will have to suffice.

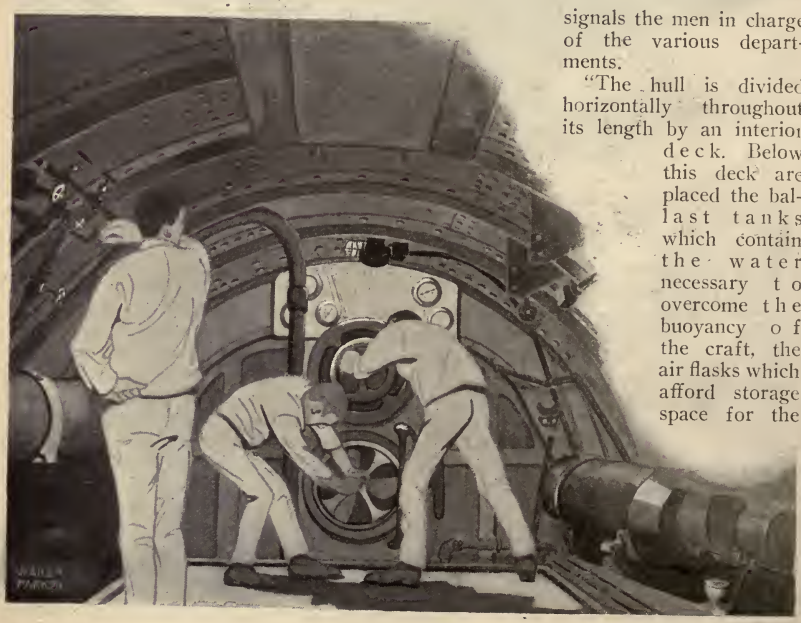
"The hull of a submarine vessel is essentially an elongated cylinder of steel, circular in cross-section and tapering to

a point or, more correctly speaking, a wedge at either end. Surmounting this cylindrical hull is a superstructure which forms a deck while the craft is running on the surface. On the central portion of the deck is the conning tower or navigating chamber in which is stationed the helmsman. This tower, originally made of a shape similar to that of a cheesebox, is now made in the form of a flattened cylinder in order that it may offer less resistance in its passage through the water. In the top of the conning tower are fixed the periscopes, slender tubes carrying an arrangement of lenses and prisms by means of which the navigator can obtain a view of the surface of the sea by looking through a device not unlike a telescope. One periscope is fixed while the other revolves through an entire circle. Inside the conning tower are the controlling devices by means of which the navigator either directly controls the operation of the boat or else



signals the men in charge of the various departments.

"The hull is divided horizontally throughout its length by an interior deck. Below this deck are placed the ballast tanks which contain the water necessary to overcome the buoyancy of the craft, the air flasks which afford storage space for the



air used in emptying the ballast tanks, firing the torpedoes, and in maintaining a constant supply of fresh air for breathing purposes; the storage battery, which furnishes the electric current used in propelling the craft under water; and the oil tanks for the storage of the crude oil fuel for the Diesel engines used for surface propulsion.

"Above the deck, forward, is the torpedo room in which the torpedo tubes emerge. These tubes are cylinders of steel, communicating with the exterior of the vessel and closed at the outer end with trap doors which open automatically when the torpedoes are fired.

"Aft of the torpedo compartment is the chamber in which the torpedoes are stored and which contains the operating mechanism for handling the torpedoes.

"In the rear of this chamber is the compartment which comprises the living quarters of the crew and here as in every other section of the craft, every available inch of space is used to best advantage.

"Then we come to the engine room of the craft. This chamber contains the oil engines which drive the boat while she is running "awash" or on the surface, the various pumps for oil, water and air, the electric motors which drive the boat while submerged and which serve as generators, storing electric energy in the battery, while the boat is awash; and the various devices which cause the boat to dive and turn.

"Outside the hull, at the stern, are both horizontal and vertical rudders which control the course of the submarine through the water."

Our little tour of inspection finished, we return to the conning tower and the order is given to clear the craft for a submerged run. The lifelines and platform or bridge are taken down and stowed in a compartment of the superstructure, all hands called below and the hatches closed and sealed.

The commanding officer stations himself at the periscope and the men at their various posts. The ballast tanks are filled and the electric motor

started; the craft settling slowly on an even keel as water is admitted. Within a few minutes the deck is awash and the waves splash up past the narrow, glass-covered slit of a porthole in the conning tower to which my eyes are glued. Not a sound is heard save the gurgle of the water as it swirls around the tower and the monotonous whine of the driving motors. Finally the signal is given to dive; the horizontal rudders are tilted and I can see the yellowish-green water rise as a haze up past my peep-hole. By this time the sun is shining and I can see its beams reflected and refracted down through the water, the surface of which appears to act as a myriad of mirrors and prisms. The commander calls me and his voice has an uncanny sound. I take his place at the periscope and see a miniature motion picture of the surface of the sea in the most wonderful colors. Occasionally the craft settles in a trough between two unusually large waves and my moving picture dissolves into a blank wall of green.

We continue to dive and I go back to my porthole, through which the sea appears merely as a dense mist of deepening green. Occasionally an object, scarcely more than a shadow, passes my window and I take it for a fish that has had the temerity to venture close to this intruder of its domain.

Word is given that the "enemy" is sighted—the enemy in this case being a target of netting at which one of our torpedoes is to be fired. I am transferred from my porthole to the torpedo room, incidentally finding some difficulty in placing my feet just where they should go in the simple process of walking. Arriving in the magic chamber at last, however, I find an accommodating pipe to which I cling in a secure, if unseamanlike, position.

The breech of a torpedo tube is opened and one of the shining cylinders is slid in place. The gate is closed and, at the signal of the commanding officer, a charge of compressed air is admitted to the torpedo tube with a screaming hiss and the miniature submarine starts on its errand of destruction. The destruction in this case, however, was limited to the perforation of the target, for our torpedo carried a dummy head. The torpedo fired, we arise to the surface to note its effect.

There followed a series of manoeuvres demonstrating the mobility of the craft and more than once I marvelled at the manner in which the vessel answered every command of its navigator. Truly, it took me back once again to the *Nautilus* of fiction and as I recrossed the nervous gangplank on our return, I could not but think of the wonderful opportunity for subaqueous exploration offered by such a vessel built for this purpose rather than for warfare.

The submarine is an accomplished fact, not an experiment. It can carry a crew of twenty-five men and give them good air to breathe for days at a time though totally submerged. It can travel nearly a hundred miles under water with one charge of its battery and some three thousand miles on the surface.

It is navigable at depths of some two hundred feet and, at somewhat less than this depth, a diver can leave a "lock" in the submarine and remain in constant verbal communication with the craft by means of a telephone.

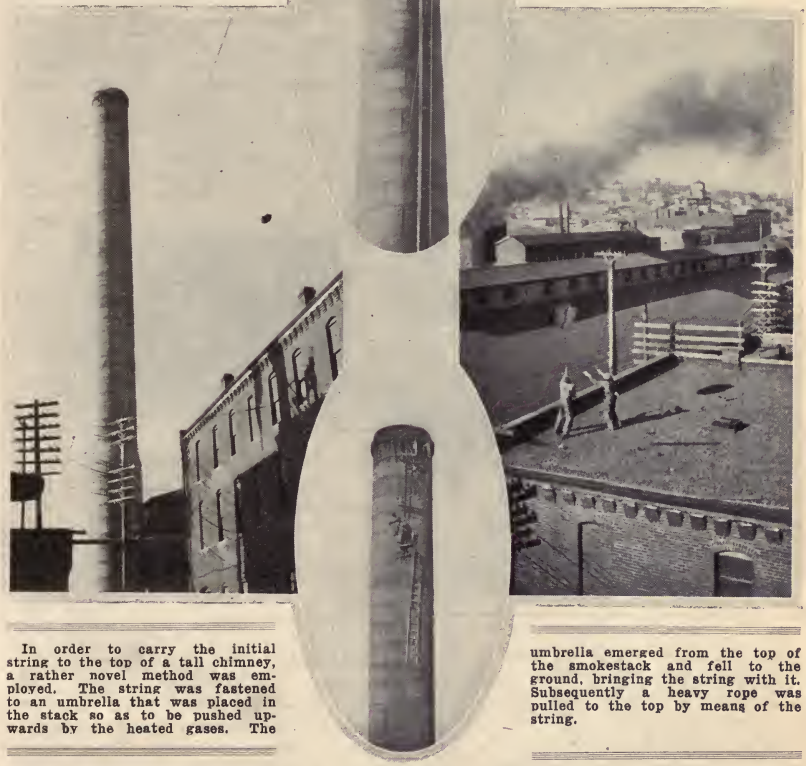
That the bottom of the sea can be explored and even photographed at a depth of sixty feet is evinced by the excellent series of photographs and motion pictures made recently by Carl L. Gregory in the Williamson Submarine Tube during a sojourn in the clear waters of the Bahamas. On this occasion, exposures were made in the one-hundredth part of a second.

With this graphic demonstration both of the practicability of the submarine vessel and of the possibility of carrying out systematic and intelligent research at the bottom of the sea, it would seem but a short step into the future when we shall have a vessel of the type depicted by Jules Verne, forecaster of the seemingly impossible—a vessel that shall carry us to the sunken coral gardens in order that we may feast our eyes on their gorgeous beauty and that may open up the portals to the vaults of untold wealth lying amid the wreckage of unfortunate ships of ages past.

AN UMBRELLA DOES UNUSUAL WORK

The hanging of large electrical signs from tall smoke-stacks and other inconvenient places has long been a source of much trouble and more expense. Steeplejacks have been employed at enormous pay.

Recently a new scheme was devised to overcome these difficulties. A block and tackle was successfully placed over the top of a very tall stack by first using an umbrella as a parachute to carry the initial string over the stack. To do this, the umbrella was pushed up through the stack far enough so that the hot gases from the furnaces caught it and carried it out over the top. It then fell downward, bringing with it a rope of small diameter. Later this rope was employed to pull a wire of proper strength over the top and then a block and tackle. By this means the large sign was strung in sections. Several umbrellas were used in the attempt, but even at that it was much cheaper than many other methods generally employed in accomplishing the same purpose.



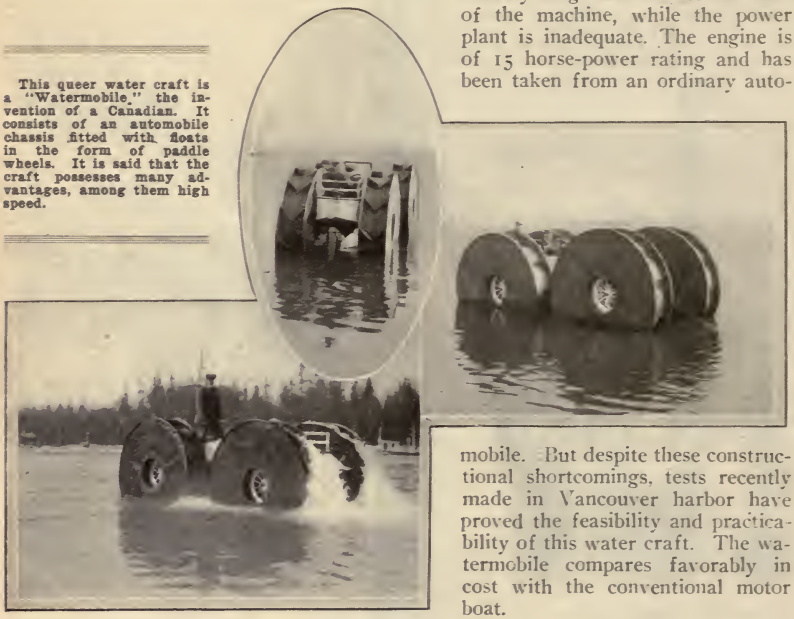
In order to carry the initial string to the top of a tall chimney, a rather novel method was employed. The string was fastened to an umbrella that was placed in the stack so as to be pushed upwards by the heated gases. The umbrella emerged from the top of the smokestack and fell to the ground, bringing the string with it. Subsequently a heavy rope was pulled to the top by means of the string.

Don't forget, the next cover of this magazine will appear as "MODERN MECHANICS."

THE WATERMOBILE

In the accompanying views is seen the "watermobile," a contrivance consisting of paddle wheels that are partially submerged and serve to give buoyancy as well as propel the vehicle. This machine is the invention of Francis W. Taylor, of Vancouver, B. C.

The demonstrating model shown in the accompanying illustrations represents the results of many years' study in an effort to cope with the greatest problem encountered in marine construction—resistance. The wheels are designed with a view of floating over the water more than of gliding through it, as in the case of ordinary hulls. The body of the car, following similar lines to the ordinary automobile chassis, is suspended from the axles of the wheels clear of the water. A special rudder contrivance is used for steering. In other respects, however, the machine conforms to the same principles as the ordinary motor car.



This queer water craft is a "Watermobile," the invention of a Canadian. It consists of an automobile chassis fitted with floats in the form of paddle wheels. It is said that the craft possesses many advantages, among them high speed.

Although in the matter of speed the inventor has not attained the results anticipated, he declares himself to be confident that the experience he has gained since the first type was placed in the water will enable him to evolve watermobiles capable of traveling considerably faster than the swiftest speed boats or hydroplanes. A hundred miles an hour is the objective of the inventor.

The model shown in the accompanying illustrations is said to have unnecessarily large wheels for the size of the machine, while the power plant is inadequate. The engine is of 15 horse-power rating and has been taken from an ordinary automobile. But despite these constructional shortcomings, tests recently made in Vancouver harbor have proved the feasibility and practicability of this water craft. The watermobile compares favorably in cost with the conventional motor boat.

KEEPING ENGLAND'S ARMY WARM

Half a million sweaters are to be ordered for the soldiers in the British army, according to reports from Philadelphia knitting mills that have been asked for estimates on 500,000 knit sweaters similar to those recently furnished to the United States army. Yarn dealers have been hastily notified to figure on the necessary prices for such a large amount of yarn as will be necessary to fill this mammoth order.

TELEPHONE BOX USED AS A MEDICINE CHEST

An odd but sensible idea is used in connection with the police telephone boxes in Los Angeles, California. Each box in the downtown district contains the necessary materials to give aid to the victims of an accident while waiting for the ambulance to arrive with doctors.

The package contains antiseptic bandages for the wounds, two antiseptic compresses of sublimate gauze in oiled paper, cambric bandages, safety pins, etc.

The police are instructed in the use of these things and it means that the bleeding from an injury is stopped with medicated materials instead of the handkerchief loaned by some passer-by—an article that is often not very clean.

The Los Angeles police surgeon, Dr. Zerfing, claims that the first dressing of any wound is the most important and if such is not cleanly done, slow healing and blood poisoning is apt to be the result.

Package of First-Aid-to-the-Injured Materials placed in Telephone Box.

He also states that the equipment of these telephone boxes is, in the end, an actual saving to the city instead of an expense, as the public hospitals are often called upon to care for these injured ones who were not properly treated in the first place, and who have accordingly contracted disease or long illness.

The highest mountain in Montana, Granite Peak, with an altitude of nearly 13,000 feet, is in the Beartooth National Forest.

Views of the Old Method of Propelling Canal Barges and the New Electric Towing Barges.

AN ELECTRIC TOWING BARGE

An electric towing barge capable of towing sixteen barges through a tunnel in 40 minutes has been recently placed in commission at the Hardcastle tunnel in England.

Formerly, the method employed for getting barges through the tunnel was rather a crude one. The men would lay on their backs on the decks of the barges and push with their feet against the wall of the tunnel. The time taken in the journey was over two hours. It was with a view to lessening the time required that the North Stafford Railway introduced the electric barge shown in the illustrations.

Don't forget, next month's cover will read "MODERN MECHANICS."

OLDEST SETTLEMENT IN THE UNITED STATES

By Albert Marple

THERE are few people more interesting as a subject for study than the native Indians of this country, and this applies particularly to the Pueblo people. The location of this peaceable tribe of Indians, now numbering about fifteen hundred, is in Arizona, in one of the hottest parts of that state. They are accustomed to the extreme warmth and they do not mind it but it is almost unbearable to the white person who may venture out near the Indians' quarters.

These Indian people have two distinct residence sections—one in the valley and one on top of a table mountain known as Acoma Mesa. The summer months are spent in the valley, where throughout that time these people till the soil and grow the produce necessary to sustain them during the winter months. There are stretches in that vast desert country where water is obtainable and it is in these sections that the Indians grow their vegetables which constitute a greater part of their food. Year after year they live in the same manner, growing their food in summer to last them during the coming winter. One of the accompanying illustrations shows one of the valley villages of these people, the homes being clustered on a smooth stretch at the foot of the hill.

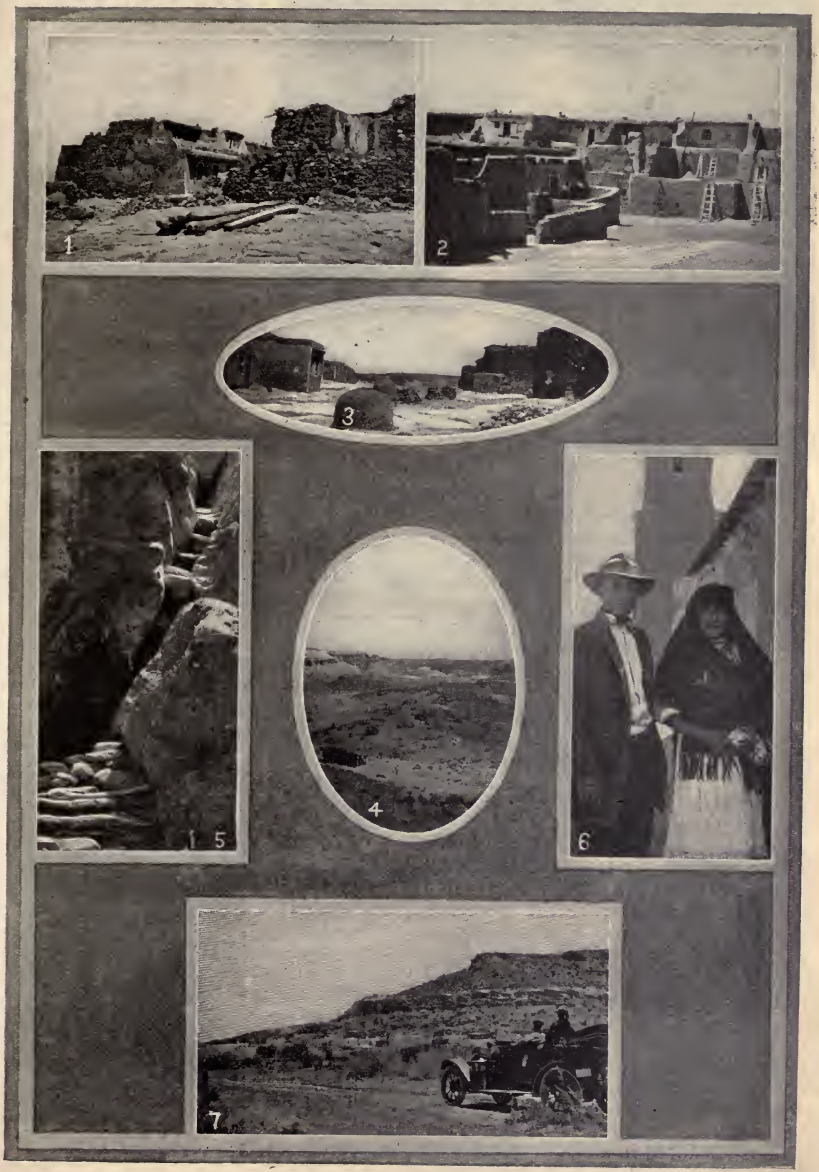
VIEWS ON OPPOSITE PAGE ARE:

(1) — Ruins of an Old Stone Church on the Mesa. In this Church the Pueblos of Several Hundred Years Ago Used to Worship; (2)—This View Shows How the Adobe Homes Are Built as High as Three Stories, as Well as How an Entrance Is Gained by Means of a Ladder; (3)—Street Scene in a Pueblo Village on Acoma Mesa; (4)—Some Idea of the Desert Country Surrounding the Pueblo Village May Be Gained by a Glance at This View; (5)—A Stone Stairway Leading Up to Acoma Mesa. The Dents in the Walls Where the Climbers Take Hand Hold Are Plainly Seen; (6)—A Pueblo Belle; (7)—Summer Houses of the Pueblo Indians in the Low Valley Where They Have Their Farms. The Adobe Huts May Be Seen Near the Foot of the Hill.

In addition to being a place of winter abode for these people, the Acoma Mesa serves as a retreat for the Indians in time of war with hostile tribes. There are only two points at which this Mesa may be approached, it being useless to endeavor to scale the sides of the smooth rock. One of these approaches is so constituted that in case of attack a huge stone may be rolled over the entrance after all of the Pueblos have reached the Mesa in safety—this barring the entrance of the foe. The other entrance, which is shown in one of the accompanying illustrations, consists of a steep stone stairway which is of such a character that at several points a single Pueblo could resist an attack of an entire tribe of hostile Indians. At these points the entrance is extremely narrow and it would be necessary for the enemy to pull himself over large rocks, during which process he could be very easily clubbed and felled by the waiting Pueblo. This stairway is so steep that it is necessary for the one who is entering the Mesa to secure fingerholds in the rocks on either side in order that he might pull himself up to the next stone. The difficulty of the ascent would make it additionally hard for the enemy to reach the Mesa. These Indians become skilled in mounting this stairway so that they reach the Mesa from the valley below with remarkable ease.

It is claimed that this is the oldest settlement of people in the United States, having been established before the arrival of Columbus in this country. It is known that this settlement existed in the 14th century, but how long before that cannot be ascertained. And a peculiar part of this village is that at the present time it is being conducted upon the exact lines that were followed in the 14th century. Upon the crumbling of an adobe hut, a new one replaces it.

Views of Oldest Settlement in the United States



The New Motorcycle Electric Headlight throws a Beam of Light Several Hundred Feet Ahead.

ELECTRIC LIGHTING FOR MOTORCYCLES

A well-known make of motorcycle has recently succeeded in developing a system of electric lighting that is proving exceedingly efficient and is reducing to no little degree the danger of night riding. The head light of this system is so powerful that it will illuminate a roadway several hundred feet in front of the motorcycle. For city riding, where ordinances prohibit the use of blinding head lights, a secondary bulb of lower candle power is provided.

A MAGNIFICENT AVIARY

In Whittier, Calif., there is an aviary that cost $700. It is private property and was built by a man whose name is W. H. Thomas. The curious thing about it is that Mr. Thomas was 91 years old at the time he put up the magnificent bird house and he did all of the work with his own hands.

From foundation to flagstaff the building is fifteen feet high and eight feet square. The four-gabled roof sets upon twelve concreted cobblestone cornerposts. Each post has a section of gas pipe through its center. The pipe is anchored in a two-foot concrete foundation. Between the corner posts there is lattice. The doorways are surrounded by scrolled ornamentations. Over each door there is a panel of artistically turned objects.

The glass windows are pebbled. Around each semi-circular window is a belt of stained windows. In the peak of each gable is a small window. A set of mechanical coo-coo birds, which Mr. Thomas devised, announce the time of day through these windows.

The structure has a gothic dome with copper roof. Along the dome of the roof runs a piece of ornamental molding with small arches. Within the arches are delicately toned brass gongs, suspended upon chains. Each passing breeze causes a musical effect to emanate from the gongs, which is a very pleasing feature of the unique edifice.

The house was built by Mr. Thomas in the idle hours of his ninety-first year to accommodate his pet canary birds, of which there are about twenty. The doors of the structure are of fine screen. They do not appear in the view since it was taken before the doors were hung. Everything estimated, the aviary cost in the neighborhood of $700. The structure is the pride of Whittier, and it is admired by everyone who chances to see it. The fame of this aviary has spread.

A Bird House built by a 91-year Old Artisan.

DAYLIGHT AND DUSK—WHICH IS WHICH?

The two illustrations shown below were exhibited in the course of a recent paper before the Illuminating Engineering Society in London by Messrs. J. S. Dow and V. H. Mackinney, with the object of showing how easily photographs can be used to deceive.

Companies interested in lighting appliances now make a special feature of photographs taken entirely by artificial light and intended to show the illumination of an interior, as it actually is. Now such photographs are a most useful weapon to the lighting engineer. But it is important to recognize that all depends on the conscientiousness of the photographer.

It is well known that photographs can be "faked" by retouching and painting the negative and the print. But it is perhaps not so well known that even without having recourse to retouching, a photograph may be caused to give an entirely misleading and false effect.

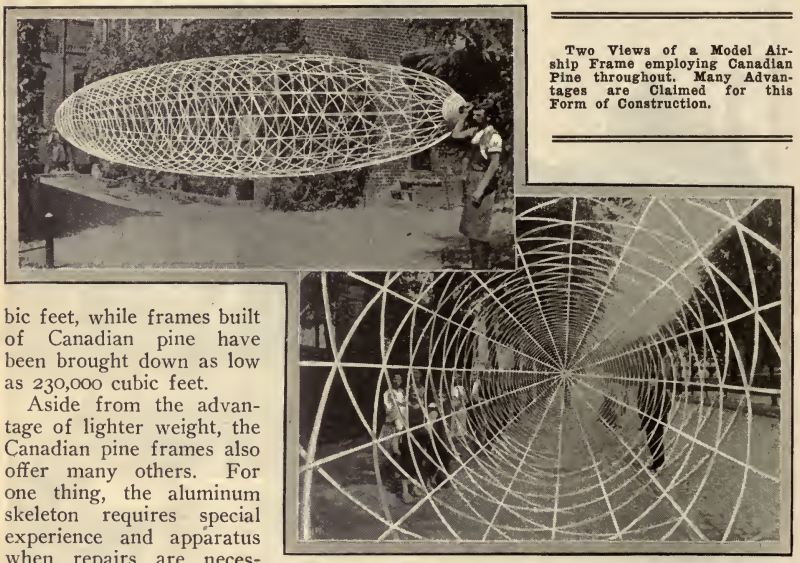
The two photographs of the house were taken respectively in full daylight and in the dusk, when the outlines of the house were barely distinguishable. *These photographs were not retouched in any way.* All that has been done is to adjust the exposure and development in the two cases with a view to producing the desired effect. Yet a casual observer could scarcely tell which of the two views was taken by daylight. It is only on closer inspection, when the shadow on the roof in the left hand view and the artificial light shining through the windows in the right hand view are seen, that one perceives which was taken by night and which by day.

NOVEL TYPE OF GERMAN AIRSHIP BUILT OF WOOD

The disasters that have overtaken several of the Zeppelin type airships of Germany have caused inventors to experiment along certain lines in an

effort to lessen the dangers with this kind of aircraft.

It has been found advantageous to employ wood instead of aluminum. After considerable experimenting one inventor has adopted Canadian pine for the framework of the dirigible. This wood is said to be one-eighth as heavy as an equal bulk of aluminum, yet it is one-third as strong. It is obvious that considerable weight can be saved by employing this wood in preference to aluminum. In its smallest size the Zeppelin type has reached 390,000 cubic feet, while frames built of Canadian pine have been brought down as low as 230,000 cubic feet.



Two Views of a Model Airship Frame employing Canadian Pine throughout. Many Advantages are Claimed for this Form of Construction.

Aside from the advantage of lighter weight, the Canadian pine frames also offer many others. For one thing, the aluminum skeleton requires special experience and apparatus when repairs are necessary and these may not be available in wartime. Another feature is that the wood is coated with waterproof varnish that is insensitive to heat, cold and moisture, while in the case of aluminum the metal oxidizes. Another advantage is that the wood is more resilient and bends in such manner as to offer the least resistance to the air. Lastly, the wooden framework does not become charged with electric currents as in the instance of aluminum. Several catastrophes have been charged to the accumulation of static electricity on the aluminum envelope of the Zeppelins and the subsequent ignition of the gases as a result of a high potential spark.

THE LAST HOME OF THE BUFFALO

The Athabasca-Mackenzie region in Canada contains many fur-bearing animals and it appears also to be the home of the last wild remnant of the American bison family. The herds of bisons, as everybody knows, are not numerous anywhere. No more so are they in the region mentioned, where, it is reported, they are being rapidly exterminated.

The Canadian musk-ox, too, inhabits this region, and in the spring, when the rivers and springs escape from the frost, great flocks of birds, including most of the migratory game birds of America, resort thither to breed.

In preparation for the coming fire season in California, 110 miles of fire lines have been built on the Sierra national forest.

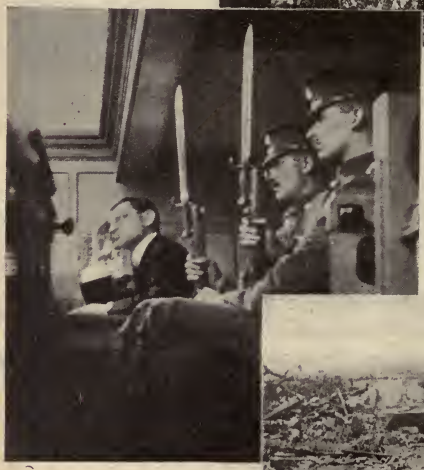
THE SINKING OF THE ENGLISH DREADNAUGHT "AUDACIOUS"

In this view is seen the sinking of the "Audacious," one of the largest and most modern battleships of the British fleet. The "Audacious" was stationed off the coast of Ireland when it either struck a mine or was made the victim of a torpedo fired from a German submarine boat. There are many conflicting statements as to the cause of the catastrophe, some claiming that the dreadnaught struck a hostile mine and others that the huge battleship was the victim of a torpedo. This view was taken from the deck of the S. S. "Olympic" and shows the crew of the dreadnaught being rescued. The port deck of the stricken battleship is partly submerged and the crew can be seen gathered on the bow of the starboard side. Two torpedo boat destroyers are standing by.

Photos. Copyrighted International News Service.

Here is a striking instance of what war means. In this view may be seen the bodies of soldiers lying on the ground just as they fell. A company of French infantry was ambushed in this forest and almost every man either killed, wounded or captured by the Germans.

A French battery in action. Artillery duels along the entire battle line in France are constantly maintained.



A scene in the court room in London in which Lody, the German spy who was posing as an American citizen, securing information of British naval activities and forwarding his findings to Germany, was tried and condemned to death. This sensational case came at a time when all England was highly excited over the spy peril. Lody was shot in the tower of London by a detachment of soldiers.

A road in Belgium. Here is seen a deserted military wagon as well as a destroyed farm house. Destruction follows in the wake of the armies.

Photos, Copyrighted International News Service.

Soldiers of the three allied armies arm in arm. Here are seen the British, Belgian and French soldiers walking together through the streets of Boulogne, France. One of the remarkable features of the war is the genial companionship that exists between the soldiers of the allied nations. Although in most instances the British troops are seriously handicapped by not knowing French, this does not prevent them from associating with the Belgian and French soldiers in every possible way. Interpreters are at hand in large numbers.

This view was taken some time ago while the Belgian army was still fighting valiantly in Belgium against the advancing Germans. A Belgian peasant woman is seen bringing walnuts to the soldiers who are resting between engagements in the trenches between Duffel and Lierre, Belgium.

At the Left: The effect of a single German shell striking a house in Rheims. This city has suffered greatly from German shell fire. Below: French outposts running to seek cover from a surprise attack of a German advance squad.

Photos, Copyrighted International News Service.

Belgian refugees sleeping outside a hut in Rosendaal, Holland. Many of the Belgians have fled to peaceful Holland and as a result the resources of that kingdom have been heavily taxed.

A battery of the famous French 75 mm. field guns in action. These guns are said to be exceedingly deadly owing to the extreme rapidity with which they can be served.

A group of British marines studying a map of northern Belgium where they are aiding the regular British army. Both English and French marines have rendered commendable service in Belgium and northern France.

Belgian soldiers operating a telephone field set. The extent to which the telephone and telegraph are employed in keeping the various commands in touch with each other and with the general staffs is astounding. A veritable network of wires is said to be in the rear of both the German and allied armies.

Photos. Copyrighted International News Service.

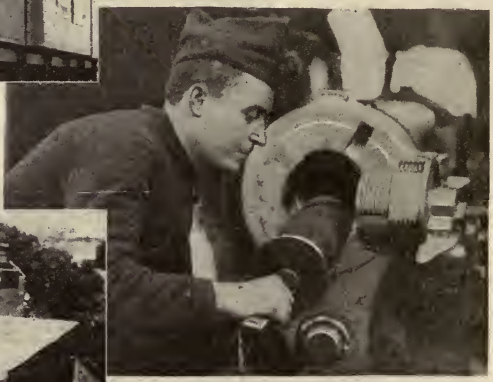
Belgian refugees from Antwerp arriving at Putte on the frontier of Holland. During the siege of Antwerp by the Germans many civilians travelled in every available form of vehicle to the boundary of Holland in order to escape the horrors of war.

Japanese artillery in action on the plains of Shantung during the siege of Kiauchau. After a persistent siege of Kiauchau, a German colony in China, the Japanese troops succeeded in capturing it with a minimum loss of life.

At the right: Japanese wig waggers signalling orders across the plains of Shantung. Above: Soldiers paying their last salute of respect to a dead comrade.

Photos. Copyrighted International News Service.

Armored train at Ypres with rifles projecting through the loop holes in its sides. The Belgian army has employed a large number of these armored trains with telling results. The riflemen are secure from hostile rifle fire yet capable of meting out severe punishment to their opponents.



A Belgian gunner placing a shell into the breech of a gun on an armored train during an artillery duel with the Germans.

A group of Belgian sharpshooters firing from an armored train near Ypres. Not only do such trains carry facilities for a number of sharpshooters, but they also are provided with one or more guns of considerable size.

During the last days of the defense of Antwerp, the Belgian and British soldiers and marines made use of numerous armored trains such as the one shown in this view.

Photos, Copyrighted International News Service.

This is the first picture of the Kaiser at the front. The Kaiser may be seen at the extreme right consulting his generals while standing on a pontoon bridge over the Meuse River.

A German dirigible of the Zeppelin type in course of construction. From various reports credited to travelers arriving from Germany, it is understood that the Teutons are now building a large fleet of Zeppelin airships presumably for an attack on the English cities.

A general view of the occupation of Malines, Belgium, by the Germans. German soldiers as well as Belgian prisoners appear in this view.

Parisians watching a German aeroplane dropping bombs on Paris. This was a frequent occurrence until the French aviators became more active.

Photos. Copyrighted International News Service.

Germans breaking up camp in Russian Poland. After having reached the very suburbs of Warsaw, Russian Poland, the German army of the East was obliged to retreat before the onslaughts of the Russians. The retreat was executed in marvellously systematic order without confusion and with minimum losses.

Belgian soldiers defending Antwerp. Here are seen the Belgian sharpshooters on the banks of the Nethe waiting to fire on the Germans advancing along the opposite bank. The smoke in the background is that from buildings set on fire by artillery.

Monitors, such as the one shown in the accompanying illustration, have played an important part in the battle of Flanders. The allied and German armies have been fighting near enough to the coast to permit of the light draft British monitors taking an active part in the artillery duels. In the oval the British marines on board a monitor are seen firing at a German aeroplane that is flying over them. The monitors are occasionally threatened by aeroplanes and submarines, but the crews are on the alert to prevent damage to their ships.

Photos. Copyrighted International News Service.

British naval gunner getting the range for a gun while Belgian members of the armored train crew stand by ready to load. In no previous war has the armored train been used to such a great extent as in the fighting in Belgium.

British gunners on a Belgian armored train near Ypres.

When threatened with the bombs of a German aeroplane flying overhead, the crew of a British armored train at Ypres brought their anti-aircraft gun into position and repelled the attack. Guns such as this can be fired at any angle and have an exceedingly long range.

British naval gunner preparing a meal on board a Belgian armored train near Ypres for his Belgian comrades. Room is at a premium on these armored trains, as may be seen.

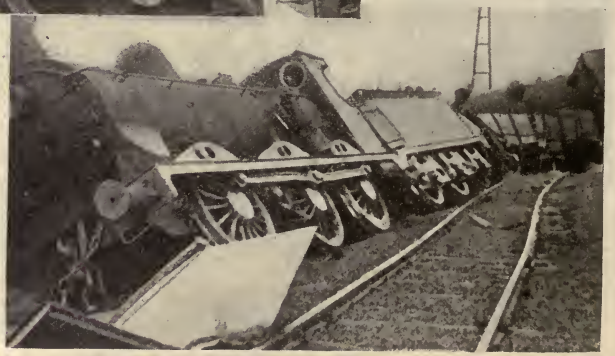
Photos, Copyrighted International News Service.

Below: The most striking feature of the European conflict has been the extensive use of trenches. In fact, earthworks have proved to be more effective against the attacks of an enemy than the most powerful permanent fortifications. Here is seen a regiment of Austrian infantry intrenched.

Above: This view conveys an idea of the remarkable efficiency of the German army engineers. In order to check the German advance the Belgians blew up a tunnel on the main line of a railroad. Here are seen the German engineers excavating the ruin.

Belgian refugees boarding a fishing smack at Ostend, Belgium, in order to be transported to England. There are thousands of Belgian refugees in England at the present time.

This locomotive and its train of cars loaded with sandbags was turned loose by the Belgians on the railroad tracks leading from Malines towards a German camp. The Germans apprehended the coming of the wild train and wrecked it by means of a barricade.



Photos. Copyrighted International News Service.

A section of a French quick - firing battery changing positions between Montmidier and Roye. Each soldier carries a portion of the mittraileuse or machine gun to the next position, where it can be assembled in about one minute.

A scene on the road leading to the firing line along the Aisne. This is quite a common sight along any road that leads to the battle-front. A constant stream of supply and ammunition wagons flows constantly back and forth bringing the necessary materials for the men on the firing line.

Below: A company of French marines bivouacing in Belgium. According to reports it is gathered that the French marines have given a very good account of themselves in several of the desperate combats in Flanders and Northern France. These men have proved resolute in holding positions allotted to them as well as valiant and almost irresistible in their bayonet attacks.

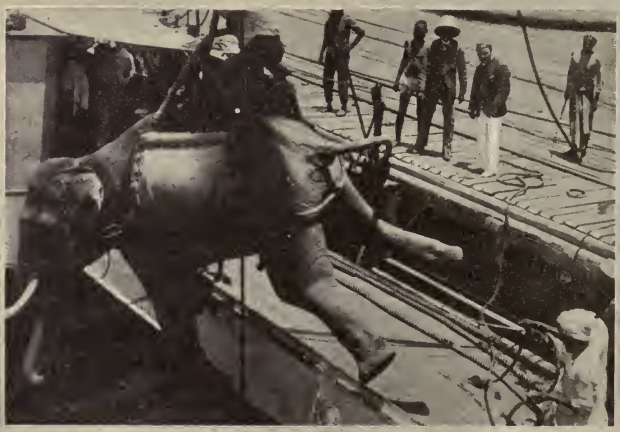
Above: For a hundred francs—about $20.00 in American money—this French soldier signalled the position of a French battery to the enemy near Rheims. He was discovered in the act and summarily shot.

Photos. Copyrighted International News Service.

At the Left: During the excavating of ancient ruins of native Indians in Peru, this oddly shaped chair was uncovered. It was probably employed by the Incas many centuries before the landing of Pizarro in Peru.

Above: Here is an American Indian watching a baseball game. The remarkable growth of hair of this Indian is much in evidence. Many Indians still refuse to have their hair cut and take pride in braiding it.

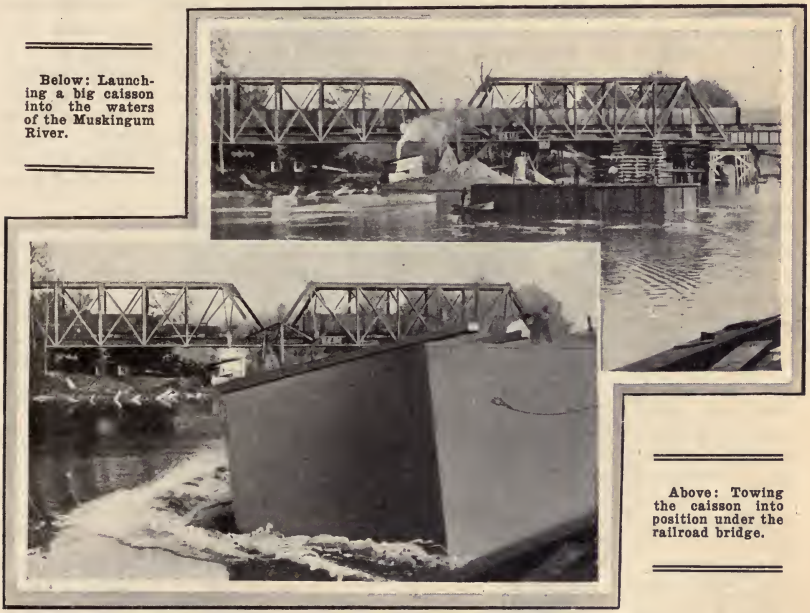
Below: One of the common sights in India is the loading of elephants on shipboard. A band of canvas, as shown in the illustration, is fastened around the huge beast and connected by ropes to the derrick.



LAUNCHING A BIG CAISSON

The accompanying views show an interesting phase of bridge building. This huge caisson, 19 feet wide and 55 feet long, was launched into the Muskingum River and towed into position under a bridge where it played its part in the construction of a pier.

The caisson slid down the ways into the river, entering the water with considerable splash. The usual custom of breaking a bottle of champagne at launchings was suspended on this occasion. A number of engineers watched the operation to see that nothing was allowed to go wrong.



Below: Launching a big caisson into the waters of the Muskingum River.

Above: Towing the caisson into position under the railroad bridge.

CENSOR APPOINTED ON RAILROAD TELEGRAPH LINES

To insure against the improper use of the telegraph wires by its employees, the Lehigh Valley Railroad has followed the policy of the belligerent nations abroad and appointed a censor.

However, the prompt handling of messages will not be interrupted by the activities of the censor as is the case with the military censors. A carbon copy of every telegram to be transmitted for an employee of the Lehigh Valley Railroad will be sent immediately to the censor, who will scan it carefully, determine whether it contains unnecessary words or could be properly handled by mail, note his comments on the message and return it to the sender. The management figures it will not be necessary to point out such useless words continuously, and that the employees will learn the lesson quickly and save the company a considerable sum of money in tolls. The censor will be located in the office of the Superintendent of Telegraph and will scrutinize every message from every office from the highest to the lowest.

Last year the fire loss on the Canadian timber reserves was the smallest ever known, only one-fiftieth of one per cent. of the area being burned over.

AUTOMATIC ARTILLERY IN MILITARY SCHOOL

By C. L. Edholm

THE development of the automobile for military purposes is indicated by the fully equipped fleet in a Wisconsin academy, which operates a number of machine guns mounted on cars, together with a couple of field wireless outfits with telescope masts set in the specially built bodies.

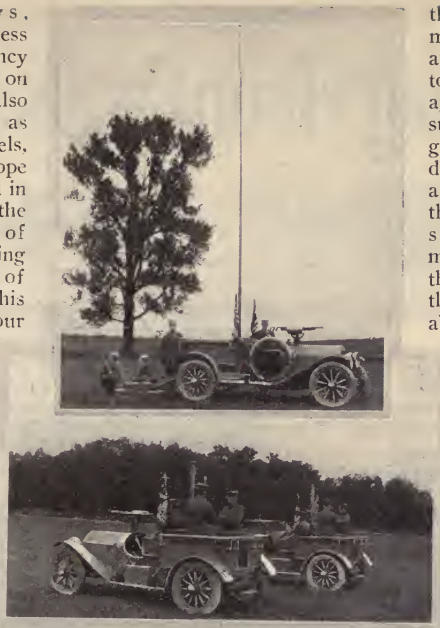
The history of this motor corps for cadets goes back as far as 1897, when a Chas. Duryea, three-cylinder automobile was secured and equipped with a Colt automatic gun. The experiment proved so well worth while that two "steamers" were built in 1901 in the manual training shops of the academy; the pupils doing almost all the work. These were likewise equipped with artillery. In 1909 a Cadillac "30" was added to the fleet.

The Cadillac car was tested over thousands of miles of travel and the results were so satisfactory that two more of the same make were added to the fleet. In 1910, a great year for aviation in this country, the students of the Northwestern Military and Naval Academy were kept abreast of the times by instruction with autos equipped with dirigible destroyers, target practice among the ranges of the clouds being indulged in. These destroyers with a crew of students made the Glidden tour from Cincinnati to Dallas, Tex., returning to Chicago by way of Omaha. Both students and cars alike were deserving of great credit because of the record made on that severe grind. These two cars were numbered among the nine successful entrants to complete the tour, although 38 started.

Shortly thereafter, the remaining two Cadillacs which compose the fleet were secured and furnished with electric generators connecting directly with the engines, wireless instruments and 45-foot telescopic masts; the latter being built at the academy shops. These two cars are now used for field work in transmitting radio messages, and in addition, the automobiles carry a machine gun, an electric searchlight and a heliograph for visual signalling, together with the neces-

Various views of the motor vehicles employed by the students of the Northwestern Military and Naval Academy. On some of the automobiles are mounted machine guns as well as a complete field wireless station. Motorcycles are also included in the equipment.

sary wires, guys, etc., for the wireless masts. Emergency outfits for use on bad roads are also carried, as well as axes and shovels, and coils of rope which can be used in connection with the "windlass" hubs of the cars for pulling the machines out of mud holes. This fleet made the tour from Lake Geneva, Wis., to the United States Military and Naval Academies at West Point and Annapolis, the party, consisting of thirteen students and the commandant, making a 3,000-mile trip. Motorcycles for scouting form part of the corps, which is said to be unique.



A wireless equipment carried by automobiles. A machine gun is mounted on these vehicles for protection against the attacks of an enemy.

Because of the important fact that in this mechanical age a boy's education is incomplete without some knowledge of the late developments in electricity, aviation and the motor car, it is encouraging to see these subjects handled together with academic training. As a matter of course, the students need slight encouragement to master these branches to the best of their ability, for it is as natural for a healthy youngster to be interested in mechanics as for a duck to take to water; all they need is a chance.

The practical experience gained through actual contact with and use of the machines places the finishing touches on the education of the young students, preparing them as it does for the many problems which are bound to arise in their after life.

HYDROSULPHITE COLORS

It is said that the fastest colors on the market are what are known among dyers as hydrosulphite—colors that are dyed with hydrosulphite in a caustic bath. These colors are as nearly fast as any can be made and have been adopted by our Government to be used in army uniforms after being submitted to very severe tests.

The dyeing of these colors on cotton yarn is very simple, especially when the Scotch tub system of dyeing is employed. The proper way to dye these colors is to use the vacuum type of dye machine, as the dyestuff experts hold that all air should be eliminated from the cotton before the dye-stuff is applied, and this type of machine is best suited for that purpose, because in this system the cotton is stationary and the dye liquor is forced through the cotton by means of pumps.

Don't forget, the next cover of this magazine will appear as MODERN MECHANICS.

Making the Iron Cross

IN view of the fact that numerous reports from Europe state that Iron Crosses have been awarded to German soldiers and sailors for acts of bravery during the present conflict, the various processes in manufacturing this military decoration are of unusual interest at present.

The Iron Cross is a Prussian military order or decoration that was first instituted by the Prussian Emperor Frederick William III as a reward for distinguished services during war. For a time it was abandoned but again revived in 1871 during the war with France. Since then these decorations have been

Pouring the Molten Iron Into Molds for Casting the Center Portion of the Iron Cross.

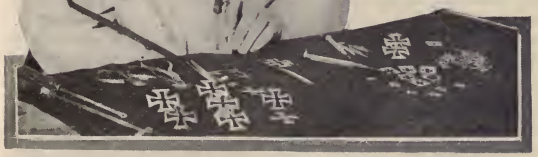
awarded to German soldiers and sailors who merit them.

The Iron Cross consists of a Maltese cross made of iron and edged with silver. It is worn suspended from the neck by means of a silk cord or ribbon, or at the buttonhole. The superior decoration of the Grand Cross is a cross of double the size and is reserved for officers of high rank who have successfully carried out a campaign, won a decisive battle or conducted a brave defense of a fortress or position.

In the accompanying views the various steps in making the Iron Cross are shown. One of the very first operations consists of pouring the iron into molds to give it the right form for the cross. Meanwhile, the silver is punched out to give it the proper shape and recess for holding the iron center portion. The silver portion is then cut to the proper shape with a very fine scroll saw. Thus the iron and silver parts of the cross are ready for assembling. Following the finishing touches that are given to the cross, the decoration is highly polished on a buffing wheel, fastened to its ribbon, and then stored away for future presentation to German soldiers and sailors.

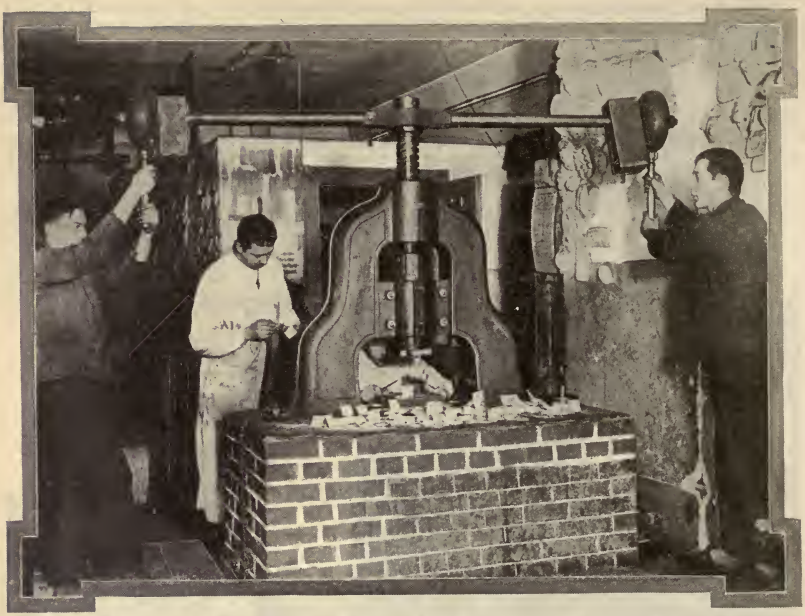
Woman worker polishing the finished Iron Cross on a buffing wheel. Below: An expert workman engraving an Iron Cross.

Photos. Paul Thompson



Using a scroll saw in order to cut out from a silver sheet the silver edge of the Iron Cross. Previously, the silver squares have been punched to shape.

The Iron Cross is a decoration of very pleasing design and is quite conspicuous among the many orders of the European nations. Since the present outbreak of hostilities between Germany and the allied nations the Iron Cross has been



Huge Manually-Operated Punch Employed for Stamping Silver Squares to the Proper Shape.

awarded to many soldiers and generals as well as to naval men. Conspicuous among the latter are the men comprising the crew of the German commerce raider *Emden* and the German submarine *U-9*.

ELECTRIC PIPE ORGANS

Even the "king of instruments," the modern pipe organ, has not been able to withstand the steady advance of electricity and to-day what are known as electric actions are being used in nearly all of the big instruments being constructed. With this system the organ and the console or keyboard can be separated; the organ being often placed in an entirely different part of the building from the keyboard. However, the real object of the electric action is to lighten the touch and, at the same time, to give immediate response when the key is depressed.

Several years ago it was discovered that the touch in large organs became so heavy that it was with the greatest difficulty that the organist could press the keys. Then compressed air came to the rescue and tiny currents of air were used to open the pipes. Although this action is still used, it is generally slow in responding and the sound may not come for some time after the key is depressed. With electricity, on the other hand, the response is instantaneous no matter how far the organ is from the keyboard. In some cases the electric action has been combined with the pneumatic.

The electric action is really a miniature telegraph. When the organist presses a key, a tiny current of electricity is sent through a wire to the pipe. This little current opens the pipe and lets the air in from the windchest. The electric action has made possible the placing of the well-known echo organ in another part of the hall from the main organ and yet connected with the same keyboard.

BIG SERIAL IS COMPLETED

Daring scenes in motion pictures are not enacted without risk to the players. More than that, injuries are often suffered by the players. The following is a doctor's report on the injuries to actors who produced the "Trey o' Hearts" serial:

"Cleo Madison, a badly lacerated kneecap and severe bruises about the back and shoulders; George Larkin, one ear nearly torn off and bruised and battered legs and body; Harry Vallejo, a sprained wrist; Leigh Smith, poison ivy over both arms and his face; Ray Hanford, a cut on the knee and bruises too numerous to mention; Rex Hodge, congestion of the lungs; Tom Walsh, sprained back; Wilfred Lucas, a pair of feet swollen and blistered until he cannot walk on them; Johnny Pierce, a broken nose."

Of the entire company not one escaped without injury or illness, and every morning and evening before the

The "Trey o' Hearts" Company on an Improvised Stage on Waterfront at San Diego, Calif. Director Wilfred Lucas and Cleo Madison are Seen in the Right Foreground.

door of the Red Cross tent a line would form of limping, coughing players, hobbling along with requests for bandages, liniment, lotions, cough remedies and a little of everything in the doctor's medicine chest.

REDUCING THE TIME REQUIRED TO DRY FILMS

Speed is a by-word in the motion picture business to-day. Speed is demanded everywhere, in the scenario, in the studio, in the camera men, in the cameras themselves, in the projection machine and in the developing room. Indeed, the only place that never seems speed-ridden about a film manufacturing plant is the drying room where the tens of thousands of recently developed films are left draped on drums for hours at a time to dry. In the past it has been considered impossible to hurry this operation. To turn fans on the moist films meant that their surface would become coated with dust; while to open windows or construct ventilating systems in the drying room presented the same drawback. But through the ingenuity of a veteran in the motion picture game, Mr. Farini, who is in charge of a large studio in Yonkers, speed has at last been dragged into the drying room.

Electric Heaters Used in Drying Room of Studio to Hasten Drying of Films.

Mr. Farini was recently given a "batch" of releases to get out in fast time. It happened that the weather was particularly humid just at that period and the films in the drying room were left hanging for ten hours before they were thoroughly dry. Ten hours for drying was out of the question on the releases Mr. Farini had in hand and he decided to try an experiment. He visited the local electric light company and secured the use of four large electric beer vat dryers. These he had connected and installed in the drying room, and much to his gratification the steady temperature they produced in the building dried his releases in exactly half an hour. That meant that his little discovery had cut down the time required to manufacture motion picture films by at least three or four hours. Moreover, on investigation it was found that the films that were dried so quickly remained very tough where the films that were left to hang for hours became watersoaked and easily torn.

A NEW PRODUCING COMPANY

With a motion picture plant that is modern in every respect, the Liberty Motion Picture Company started active operations a number of weeks ago. The plant is situated at Germantown, a prominent suburb of Philadelphia. Mr. N. E. Milligan, a former stage director in stock as well as productions, has been engaged as head producer. Milligan is at present absorbed in his fourth multiple reel photo-play. Howard G. Bobb is general manager of this new company. The factory of the company has the capacity for turning out four million feet of the finished product per week. In the studio there is adequate space for sixteen good sized sets.

The releases now in preparation will be put into circulation in the near future.

The cover of the next issue of this magazine will bear the new title "MODERN MECHANICS."

IMPRESSIONS of the THANHOUSER PLANT

By Austin C. Lescarboura

ABOUT forty-five minutes from Broadway, New York, on the road to Boston, is the thriving city of New Rochelle. Many are the industries for which New Rochelle may justly be proud, but probably none is regarded with greater pride than that of producing photoplays.

New Rochelle is the home of the Thanhouser studio. Thanhouser and New Rochelle are inseparable: the mentioning of one calls for the other. Just the word "Thanhouser" on a letter mailed in New Rochelle will speed that letter straight to the Thanhouser studio. If the production of a Thanhouser photoplay calls for a few fire engines, they are immediately placed at the disposal of the producer. Indeed, the Thanhouser directors may consider anything in the city at their disposal if the scenario demands it. Hence an ultra-liberal amount of realism in Thanhouser films.

I recently had the good fortune to visit the Thanhouser studio and be shown through the numerous departments of this industrious community—or should I say "family," for never have I witnessed a more homelike atmosphere and spirit of good fellowship in a manufacturing establishment. At any rate, I had an opportunity of seeing the home of the Thanhouser films from the camera to the shipping tin, or, putting it in metaphorical terms, from the cradle to the leaving of home for the outside world.

The Thanhouser is housed in two large concrete buildings. One of the first things that catch the eye and admiration of the visitor is a garden that fronts the street leading to the buildings. At the time the writer visited the studio this garden was laid out with a ledge of rocks in the background, down which leaped a waterfall. The water gathered in a rocky basin below and then flowed over numerous boulders into a cave. Two rustic bridges, trees and other bits of foliage completed the landscape. And the remarkable feature of this garden was that everything—even the large, rocky ledge in the background—had been constructed by the studio carpenters, entirely of wooden framework and canvas painted in photographic colors much in the same manner as an artist retouches a photograph for halftone engraving purposes. But this is not all. The brook entered the cave for a very definite and remarkable purpose.

Under a wooden platform on which scenes are staged when weather permits, I was led into a wonderful under ground cave. It consisted of many little passages, grottoes, out-of-the-way corners and large chambers, all bound in by rocky walls marred with the most grotesque stalactites and stalagmites. Through the cave passed the brook; the water being sufficiently deep to float a flat bottom row boat. And as in the instance of the outdoor scenery, the entire cave was constructed of wooden framework and painted canvas.

All of this scenery was employed in certain episodes of "The Million Dollar Mystery." It is indeed difficult for any-

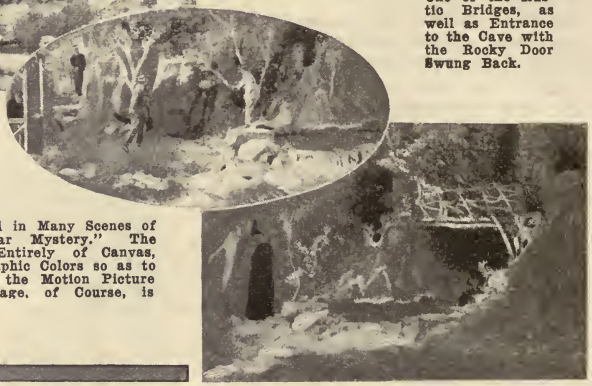
one who has seen reels of this serial, in which the cave is employed, to be convinced that the cave is not a natural one.

The property room of any studio is one of the centers of interest. In a measure it aptly signifies the scope of the producer—his facilities—or call it stock in trade if you desire. If the property room of the Thanhouser be regarded as a criterion, the facilities of this studio are well nigh unbounded. Not even in a large metropolitan furniture store would one find such a complete and varied assortment of house-furnishings, much less the fittings for offices, bar rooms, churches, schools and what not. I would unhesitatingly challenge anyone to suggest some indoor scene that could not be rendered with the proper atmosphere in the Thanhouser studio. Perhaps I am too enthusiastic, for giving the matter further thought it is quite possible that ancient scenes or others entirely out of the ordinary could not be fitted up from stock. But then there are the studio carpenters to reckon with.

In one section of the studio there is a large space devoted to the carpenters. These men are clever and ingenious artisans, skilled in their calling and capable of turning out any piece of property that may be necessary in producing a photoplay. For instance, in "The Million Dollar Mystery" the men constructed a safe of wood and cardboard, painted with aluminum enamel, that surely defied detection in the film. Even the bolt mechanism could be operated by turning the usual lever handle, although the bolts consisted merely of wooden sticks finished in aluminum. Another clever piece of property was a rural fire department pump and hose cart that later added much mirth to a farce comedy film.

You must not assume by the foregoing that everything in producing photoplays is intended to deceive the camera. This is far from being the case, for where actual furniture can be employed it most certainly is. In one set for the "Zudora" series I have seen $2,000 worth of new furniture used for the first time.

In the View to the Left is Seen the Swinging Rock that Covers the Entrance to the Cave Featured in the "Million Dollar Mystery." This Rock is Made of Canvas and Operated by a Stage Hand Hidden Behind it. In the Oval the Swinging Rock is Seen Closed Over the Entrance. Below: One of the Rustic Bridges, as well as Entrance to the Cave with the Rocky Door Swung Back.



In These Views is Seen the Wonderful Artificial Scenery Erected in the Yard of the Thanhouser Plant and Employed in Many Scenes of the "Million Dollar Mystery." The Rocks are Made Entirely of Canvas, Painted in Photographic Colors so as to Completely Deceive the Motion Picture Camera. The Foliage, of Course, is Natural.

Before concluding the preparation of sets it is but fair to say a word regarding scene painters. These workers are busily engaged in painting the background and side walls for sets. They work in a long, narrow room, along one side of which is placed the huge surface to be painted. This surface may be raised or lowered on a suitable framework through a long slot in the floor, so that a painter standing on the floor can reach any part of the surface without difficulty.

Aside from the property room containing the furniture there is still another room devoted to small pieces. It would be next to impossible to cover the entire contents of this room. Shelves of great length and extending from the floor to the ceiling are loaded down with small objects of all kinds. Here are a few selected at random:

Views of the Property Room

In These Views May be Seen Different Corners of the Furniture Property Room, as Well at the Small Property Room Where Ornaments and Other Similar Articles are Kept on Shelves. The Variety of Furniture in a Studio Property Room is Astounding. Furniture of Almost Every Kind Dating From the Colonial days to Modern Times is at Hand Ready for Immediate Use in Any Scenes Called for in Films. The Same Completeness is Much in Evidence in the Property Room for Small Objects. Clocks, Lighting Fixtures, Ornaments, Mirrors, Instruments of all Kinds—in Fact Every Small Article that is Apt to be Called for in a Film—are Found on the Shelves.

Telegraph and telephone instruments, doctor's instruments, ornaments of all kinds, firearms of every conceivable type, picture frames, mirrors, clocks, every object can be found. Ask for a bedroom setting and the men will bring in the furniture in keeping with the story, place the various pieces in posi-

One of the Companies Engaged in Producing Princess Brand Comedies at the Thanhouser Studio. The Three Groups Represent Soldiers, Civilians and a Police Force in a Side-Splitting Comedy entitled "The Dead Line."

chandeliers and lighting fixtures. Take, for instance, the single item of clocks. There are alarm clocks, grandfather's clocks, mantelpiece clocks, bureau clocks, wall clocks and so on down the line. The stock clerks know where tion, use the proper bedding, arrange a scarf on the bureau with the proper articles neatly laid out on top of it and attend to the numerous other details that insure realism.

The studio proper is an immense

glass covered room in the same building as the property rooms. At least ten sets can be employed at once on this floor; at the time the writer visited the studio at least one-half of the floor space was taken up with sets of the "Mystery" films—left standing until the series was completed—yet leaving ample room for six other active sets.

The lighting of the studio is aided by the glass roof; the studio being a daylight one. Under the glass there is an elaborate system of shades that can be adjusted so as to vary the intensity of the light over any particular part of the floor. When the daylight is not of sufficient intensity, arc lamps are employed. These comprise several carbon arcs enclosed in a metal hood and mounted on casters to facilitate moving them to any part of the floor.

To properly describe the work of the directors and actors is rather difficult, at least in so short a space. To a visitor watching the activities in the studio the general impression is that of several independent groups of individuals, each absorbed and at work on its own particular problem and seemingly disinterested in the work of the others. The sets comprise a back wall and two sides, furnished with such fittings as may be necessary. The actors are quite shut in from the outside world by the walls. In front stand the director and the camera man with his machine. When everything is in readiness for taking the scene, the director shouts "lights," bringing several electricians on the run with arc light stands that are soon connected to the source of current by long, flexible cables. Elsewhere may be seen stage carpenters busily engaged in erecting a set; in another part of the studio the carpenters are demolishing a set; while perhaps in a corner may be seen a director surrounded by his company to whom he is explaining the action of the scenario.

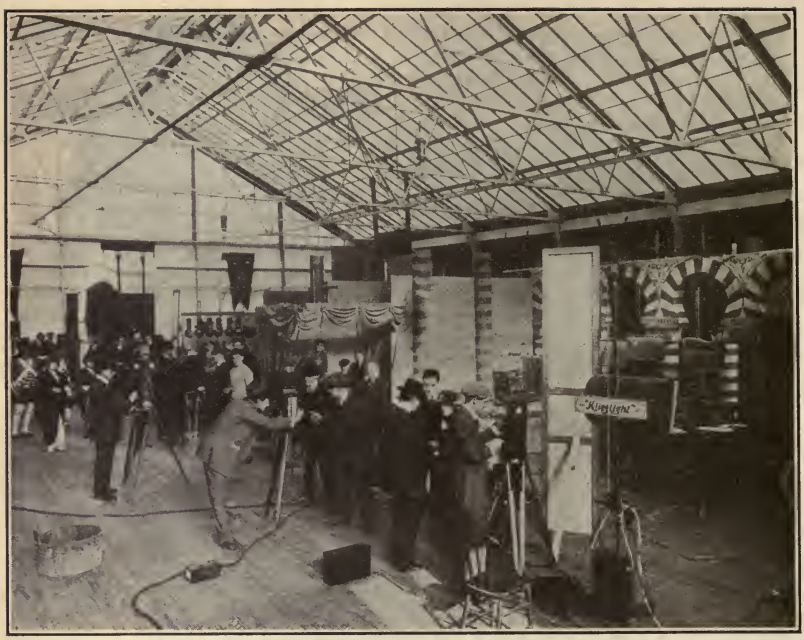
The handling of the film is a most interesting part of the Thanhouser plant. This is accomplished in another building from that occupied by the large studio, although there is a

One of the Rustic Bridges Constructed by Stage Carpenters in the Thanhouser Yard.

daylight studio of lesser magnitude housed under the same roof as the developing and printing departments.

The developing room is entered through a winding entrance, so constructed as to effectively shut off all light, yet permitting the free passage of air. For the first few moments it is impossible for a visitor to see anything and in consequence he feels helpless. After a time the oblong red lights are visible around the room and by their dim rays may be seen the long, narrow tanks in which the film is developed. The celluloid strips are wound on simple wooden frames and allowed to remain in the developing tanks for the required length of time. The dark room hands occasionally lift a frame from a tank and bring it in front of a red lamp to ascertain the extent of the development. In other tanks the films are fixed and washed.

The room where the films are printed, *i. e.*, where the positive films are printed from the negative, is perhaps more interesting than the dark room.



A General View of the Huge Daylight Studio in which Thanhouser and Princess Brand Films are Staged. In this Picture the Arrangement of the Different Sets is Clearly Seen.

It is also entered through a winding passageway that excludes all outside light. In this room there are a number of printing machines constantly clicking away. It may be added that the red lamps are brighter in this room than in the dark room; the positive film stock being less sensitive than the negative. The printing machines appear as so many fire-flies with their flickering red lights. As the negative and positive strips move along one picture at a time, a shutter opens for an instant and permits the rays of a powerful light to pass through. By observing the relative strength of the red light through the moving film strips, the operators can determine the intensity of the negative and time the printing accordingly.

After the films are developed they are dried in a special room that is kept warm and dry, the celluloid strips being wound on cagelike wooden frames. When the strips are thoroughly dry, they are ready for assembling.

The assembling room is equipped with long, low tables at which sit many girls engaged in piecing together the various strips of film that go to make a complete reel. It is most interesting to watch these girls working, for they are extremely apt at handling the film. Each has a reel and stand at her right on which to wind the film as fast as it is assembled. Little rolls of film are piled about, each accompanied by a strip of paper marked with the name of the film and the number of the scene. Each girl has a typewritten list of the scenes in the order in which they should be assembled. The workers take the different lengths in proper sequence and cement them together with liquid adhesive. Another part of this work consists of polishing the film

strips. The girls wind the strips on large, wooden, cagelike frames that have been covered over with soft cloth. The surface of the film is then gone over with a cloth as well as with the palm of the hand until it is lustrous and without spots of any kind.

When a film has been assembled and finished, it is sent to the projecting room. Here are found two motor-driven projecting machines attended by two men. The film is taken out of its tin and placed in one of the machines. The operator has before him the typewritten assembly sheet. It is his duty to compare the projected film with the assembly sheet, making sure that the scenes, leaders and inserts follow in proper order and are without flaw. After being thus inspected and found correct, the film is placed in a flat tin can and is sent to the shipping room, there to be shipped to the exchanges throughout the United States and the world. From the exchanges the film ultimately finds its way to the motion picture theatres and the audiences.

AN EXCITING AEROPLANE ACT

Sliding down a rope from a fast flying aeroplane and landing on the hurricane deck of a freight train moving forty-five miles an hour is a job that would make almost any soldier of fortune look to his laurels. It has all the thrills of war and none of the emoluments of heroism.

Charles Gorman of the Majestic-Mutual forces did the trick recently near the Mutual's Los Angeles studios, and did it not once, but twice. First, he rehearsed it so that W. C. Cabanne, director of "Out of the Air," the play for which the thriller was staged, should be satisfied it could be done, and then Gorman "went and done it."

Captain Hodgson, a well-known California aviator, handled the machine, and F. A. Turner and Signe Auen were on hand, ostensibly as principals in the production, but really, as they thought, to serve as first aid to the heroic dead. Gorman liked the stunt so well he has offered to do it again some day. He is not being crowded one little bit for his job.

TWO WELL-KNOWN FILM PERSONAGES

In the accompanying view is shown D. W. Griffith, the well-known motion picture director comparing notes with Harry Aitken, President of the Mutual Film Corporation. Mr. Griffith is credited with having brought the film drama to its present state of perfection and importance. He is the originator of many of the now common effects in photoplays, chiefly the gradual opening and the fade-away at the beginning and end of a film, the "flash back" where a story occasionally flashes from one scene to another to indicate simultaneous incidents and hold the audience in suspense, and the slow and emphatic acting—particularly facial expression—coupled with close-up photography.

Messrs. D. W. Griffith and Harry Aitkin—Two Well Known Personages in Filmdom.

ACTING IN SULPHUR MINE HARD ON SHOES

"Sheriff" Arthur Mackley and Howard Gaye each was forced to purchase a new pair of shoes as the result of putting on the Reliance-Mutual thriller, "The Miner's Peril." The company used an old sulphur mine in the Topanga canyon in the Santa Monica mountains for the mine shaft. The ground near the mine shaft was so hot from the sulphur fumes that it burned the players' shoes. The company was able to work only a half hour.

NEW FEATURE PRODUCTION WITH A CAST OF 15,000 PERSONS

There have been many feature photoplays of six, seven or even eight reels with casts totaling 3,000 to 5,000 people. But it has remained to the daring of the famous director D. W. Griffith of the Mutual Film Corporation to produce a feature entitled "The Clansman" in some scenes of which appear 15,000 persons. Beyond any doubt this is the first time that casts in excess of 10,000, or, for that matter, probably over 5,000, have been employed in a film production.

There are 12,000 actors in this production who take part as soldiers of the United States army, as members of the famous Ku Klux Klan, as natives of the city in which the dramatic action takes place, and as the objects of the wrath of all these people. Three thousand more actors are negroes, fleeing from the Ku Klux Klan organization.

One may gauge the magnitude of the action by the following incidents: Once the 3,000 negroes, who were driven from their homes by the Ku Klux Klan, really took fright at the savageness with which they were attacked and more than half of them refused to return to work. As a result the director had to hire about 2,000 negroes and photograph the scenes over again in which the black folks figured. One of the leading men, Henry Walthall, as well as Director Griffith, both had bad falls from their mounts. In one instance Griffith's horse fell upon him in a mad gallop across country, with the result that the film had to be delayed several weeks until he recovered.

MINING CAMP CONSTRUCTED FOR "MOVIES"

In the new Universal serial, "Master Key," the director, Bob Leonard, has gone to no little expense and trouble in order to have constructed a thriving mining camp in the midst of the Californian mountains. There are a half dozen or more shafts sunk into the side of a mountain at various points, with car tracks issuing from their mouths and running on to great dumping mounds. There are the powder and tool houses, piles of logs used for beaming the tunnels, scores of ore cars, well constructed shacks for the miners and their families, as well as everything else that is necessary for giving the scenery a true mining camp appearance. The entire atmosphere of the mining camp is most realistic and leaves absolutely nothing to the imagination of the audience.

GERMAN GOVERNMENT TAKING MOTION PICTURES OF WAR

It is reported by one of the American correspondents in Germany that the German government has commissioned the Express Film Company, a connection of Pathé Frères, to take official moving pictures during the course of the war. These pictures are designed to disprove the charges of German atrocities. Under certain conditions scenes of actual fighting are being taken. The conduct of the German soldiers after the capture of a city is being recorded by the motion picture camera.

Being hoisted from a swiftly moving motorboat on to a hydro-aeroplane while traveling at full speed over the Pacific, is the experience of Signe Auen in the political story, "On the Wings of Love," just produced by W. Christie Cabanne of the Majestic-Mutual forces.

THE LATEST IN CONCRETE

In the accompanying views are seen a few of the latest applications of concrete in Pasadena, Calif. And in view of the fact that California leads in the artistic employment of concrete, these examples may be considered as the most advanced in the field.

In the center view is seen the Women's Rest House in Library Park, a striking example of a concrete building of attractive architecture. In the oval to the left is a park bench, the ends of which are of concrete and serve to hold two heavy boards that are held in place with pegs. Such a bench may be constructed at a cost of about $10. In the topmost view is seen a street sign located on the curb stone. These concrete signs may be made at a cost of but $4 and they are proving highly useful as well as adding to the decorative appearance of the concrete walks and curb stone. In the right hand oval is seen a similar idea applied to house numbers. In beautiful contrast to the white concrete are the many bronze lamp posts that are being employed in lighting the thoroughfares of Pasadena. In the lowermost view is seen one of these artistic lamp posts as well as the name of a home on a small concrete slab.

It is undisputedly admitted that in the matter of artistic employment of concrete for a wide diversity of purposes, the cities in southern California are far more advanced than other American cities. Concrete is used in many ways and for almost infinite purposes in California. Many of these applications are new and even unknown to Eastern home builders. Concrete is not expensive to employ and is exceedingly durable, while its appearance, when properly combined with wooden trimmings, is pleasing.

The AMERICAN WORKSHOPS of SANTA CLAUS

Photos. Paul Thompson

THE American Santa Claus is thinking hard these days as to how he can fill the stockings of his many American youngsters to the brim. His German workshops, heretofore producing the greater part of the toys for young America, are now closed because of the European war. It presents quite a problem for this mythical gentleman to meet the unprecedented emergency, for no aid can be counted on from Germany. It is in the United States that the shortage must be met.

In Massachusetts, not far from the New Hampshire border, is the town of Winchendon, thriving in the shadow of Mount Monadnock. Winchendon is America's Toy Town. It occupies the same relative position in American industry as Nuremburg does in Germany. In fact, the New Englanders are prone to call it "The American Nuremburg." It is to the artisans of Winchendon that Santa Claus has appealed for the greater supply of Christmas toys, and the scenes of extreme activity in the town are ample proof that the appeal has been heard —and answered.

Winchendon is essentially a Toy Town. The very atmosphere reverberates with the spirit of Toyland. As the train pulls into the station the visitor to the town is surprised to find a huge rocking horse standing on the green near the depot. It is the idol of the town—its very spirit as it were—a huge toy that symbolizes the *raison d'etre* of the town.

Winchendon is also a manufacturing town. Yet it has none of the characteristics that are usually closely associated with a highly industrial community. There are no closely grouped and ugly

workingmen's homes; no tall, dirty, smoke-belching chimneys, nor grim factories with barren, cheerless walls,

Above: Workman Using Airbrush to Spray Paint on Wooden Horse. These Toy Animals are Turned Out in Large Quantities at Winchendon.

At the Left: Women Packing Wooden Animals into Noah's Arks. Below: Workmen Modeling Wooden Horses with Saws and Scrapers.

bounded by dark, narrow streets. Instead, the visitor is surprised to find gay, clean cottages that house the happy workingmen; the white walls of these homes standing in sharp yet pleasing contrast to the neat and extensive lawns that surround them. The three toy factories are just outside the village, forming the points of a triangle the sides of which encompass the town of Winchendon. The factories are clean and inviting, and surrounded by toy gardens.

The entire importation of toys from Germany in 1913 was valued, at wholesale rates, at $8,856,575. During the same period the American manufacturers produced playthings valued at $8,264,000. But the latter sum includes such products as sleds and other similar articles that cannot be strictly termed toys, so that eliminating articles of that nature and considering only the actual toys, the amount is estimated at about $4,000,000. When war broke out in Europe, only one-third of the total amount of toys to be supplied by Germany had been delivered to American distributors. The remaining two-thirds was to be shipped some time between July and the Christmas holidays. On the face of these facts it would appear that American manufacturers must supply additional toys to the value of $6,000,000 to meet the shortage caused by the commercial isolation of Germany. But in actuality this is not the case. For one thing, since war has broken out shipments of toys have been received from Germany. True they

were insignificant when considered by themselves, but figured collectively they helped swell the total of German toys now on hand in America. Then again, there is the large supply of toys left over from last Christmas. Each year the toy dealers have a considerable amount of unsold goods which are packed and stored for the following year. Indeed, this is one of the principles of this line of merchandising.

It is now obvious that the toy makers of Winchendon have not as great a task before them as the plain facts would indicate, yet the problem is none the less a difficult one to meet for this year. And it is not this year's demand only that must be met. It is stated by authorities that should the war suddenly end now, there is scarcely a chance that Germany would be in a position to furnish toys for at least three years to come. Furthermore, with the great costs of the war that will have to be met by the people of Germany whether victorious or otherwise, it is probable that German toys will have to be sold at a price that will cause their elimination from the American market in favor of domestic products. Thus it is plain that the Winchendon manufacturers have a task before them which promises to be a perennial one. To sum the statements that have been made by leaders in the toy industry: It is indeed doubtful if America will ever buy toys in great quantities from European manufacturers.

Winchendon is ready to meet any demands that Santa Claus may make on its toy shops. More men are being employed to turn out the toys and wings are being added to some of the factories. The Toy Town has heretofore produced about two-thirds of the toy drums and over one-half of the musical chimes, rocking horses, blackboards, and dolls' trunks made in America. It also turns out a large percentage of the dolls' furniture, mechanical toys and pianos that bring joy to the hearts of the American children. From the Winchendon factories there flows forth to American markets a constant supply of wooden toys such as dolls' houses, bowls, washing machines and toy boats, including such games as ten pins and ring toss. Each day one of the factories turns out 7,000 toy drums retailing at 10 cents each, as well as enough dolls' trunks to fill seven freight cars.

Women Workers Putting the Finishing Touches on Wooden Horses.

The war has not been all in favor of the toy makers of Winchendon. Many of the materials employed by the factories have, in the past, been secured from countries now at war. For instance: A certain grade of burlap used in covering doll trunks has always come from Dundee; the zinc has come from Antwerp; the dyestuffs and inks have come from Germany. But American ingenuity is rapidly finding substitutes and the manufacturing of toys goes on undaunted.

It must be admitted that German toys will be missed this Christmas. While domestic toy makers can duplicate almost all of the German toys—and even improve on them in many instances—there are certain toys that they are unable to supply. Perhaps the most striking of these are the mechanical toys turned out in immense quantities by German manufacturers and sold at extremely low prices. American toy makers frankly confess their inability to supply the demand for these toys this year. German manufacturers have long been making a specialty of simple mechanical toys. They have devised special machinery to turn out these products in such large quantities and at such low costs that the field is certainly their own beyond competition. But American toy makers, in the same breath as the confession of their inability to make these toys, will tell you that the demand for mechanical toys is negligible in volume. They claim these toys are only sold when shown—that seeing them creates the demand which did not previously exist.

The Gluing of Wooden Toys Calls for Dexterity and Extreme Neatness.

Santa Claus is relying mainly on Winchendon to have this Christmas mean as much to the American youngsters as ever. His representatives, the retail toy merchants, are looking to Winchendon for their goods. With the artisans of the quaint Toy Town of America working 24 hours a day and with added facilities of all kinds, the youngsters are not doomed to disappointment. And what is more, the greater portion of the toys will bear that legend that is coming rapidly into its own in every line of manufacturing—"Made in America"—truly a feature of this Christmas that must bring cheer to the patriotism of all Americans.

Don't forget that the next cover of this magazine will appear as MODERN MECHANICS.

RAISING STATUARY AT THE PANAMA-PACIFIC INTERNATIONAL EXPOSITION

The method employed in raising the great pieces of statuary to their high positions on the buildings of the Panama-Pacific International Exposition by means of a traveling steam crane is indeed novel. The statue seen in the illustration weighs 3,000 pounds and is 14 feet in height. The normal length of the boom on the crane is 40 feet. The extension, as shown in the picture, is 66 feet long, making a total length of 106 feet. With this equipment an average of 50 statues in one day are raised to their permanent positions. The height of the parapet shown in the photograph is 65 feet. Unusual facilities are offered for crane work and for the handling of exhibits at the exposition by reason of the standard railroad tracks which run into each exhibition palace on the grounds.

Not only is the railroad system which extends throughout the exposition grounds employed in the handling of statuary, lumber and various

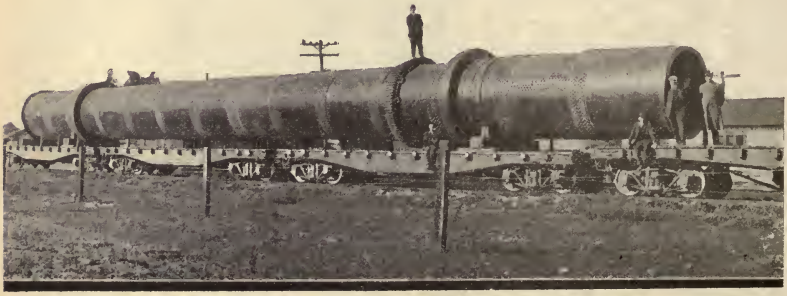
Steam Derrick Placing a Statue on a Building at the Panama-Pacific Exposition Site.

supplies, as well as rare trees, including palms from distant parts of the world, but by means of the exposition ferry slips where freight cars are landed direct from the trans-continental lines upon the grounds, the exhibits may be brought from all parts of the country without any extra handling. The cars in which the exhibits are originally shipped are switched directly onto the rails of the Exposition Terminal Railway and are run into the buildings to which the exhibits are consigned.

When all the exhibits are installed, the tracks will be covered over, buried beneath roadway and lawn, until the end of the exposition. Then they will again be exposed to be used in the removal of all that was brought into the exposition grounds.

FOUR FLAT CARS TO HAUL SINGLE PIECE OF FREIGHT

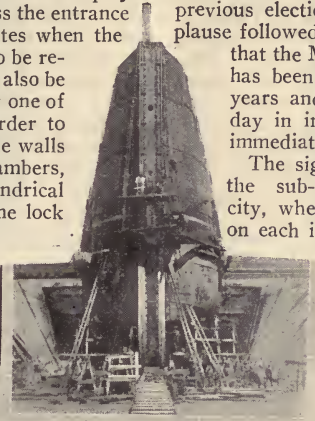
A steel tube 120 feet long and ten feet in diameter was hauled across the continent recently, requiring four flat cars to haul it. The weight was 149,000 pounds, and it is said to be the largest single piece of freight ever shipped by rail for such a distance. It travelled from Wilkes-Barre, Pa., to a cement plant in Riverside, Calif., where it is to be installed as a kiln in one of the leading cement producing sections of the country. The huge tube was set upon swivels resting on the ends of the cars in order that it might take the curves. When the consignment reached the Salt Lake station in Riverside, the pipe was covered with inscriptions scribbled by persons along the route, indicating the attention that the great pipe had aroused.



Four Cars Were Required to Haul this Steel Tube Measuring 120 Feet in Length and Weighing 149,000 Pounds.

A GIGANTIC CANAL GATE

Recently a large concern in San Francisco finished building for the Panama Canal the largest floating gate of its kind ever constructed. This gate will be used in connection with the maintenance of the Panama Canal. It will be employed as a barrier or dam across the entrance to anyone of the lock sites when the mitering lock gates are to be repaired or painted. It can also be used for unwatering any one of the lock chambers in order to make an inspection of the walls and floor of the lock chambers, as well as the cylindrical valves installed within the lock walls.



End View of the Gigantic Floating Gate While Still on the Ways.

Below: The Gate being Towed by an Ocean-Going Tug to its Destination.

At the Left: The Canal Gate at the Moment of Launching at San Francisco.

It required 1,500 tons of structural steel to build the caisson and 800 tons of permanent ballast placed in its bottom to give it stability in its light draft position The caisson has been taken to the Isthmus of Panama on a tugboat.

NOVEL WAY OF ANNOUNCING ELECTION RETURNS

The results of a bond election held in St. Louis, Friday, November 6, were flashed into 50,000 homes and practically all of the theatres within five minutes after the last vote was counted, by means of signals sent over the electric light wires to all parts of the city.

By a code of "winks," made known in advance, everyone who was in the vicinity of an electric light knew that a $2,750,000 bond issue had finally been authorized after being rejected at three previous elections. In many places applause followed the lights' announcement that the Municipal Free Bridge that has been standing idle for three years and costing the city $490 a day in interest, would be finished immediately.

The signals were operated from the sub-stations throughout the city, where the switch was pulled on each individual trunk line. The time consumed in announcing the news was less than five minutes.

SEARCHLIGHTS FOR EXPOSITION ARE TESTED

Recently a test was made of the 950 big searchlights and reflectors mounted on the roofs of the palaces of the Panama-Pacific International Exposition. The most extraordinary feature of the test was the fact that the globe surmounting the Tower of Jewels was seen 70 miles out at sea. The Tower of Jewels is hung with 125 cut-glass gems of many tints covering the struc-

ture from the summit, 348 feet above the ground, to a point 98 feet below. On this structure the beams of 50 fixed searchlights located at vantage points on all sides of the tower will be played.

ELECTRICAL ENERGY SOLD IN WORLD'S PRINCIPAL CITIES

The use of electrical energy for industrial and domestic purposes is not nearly so general in Europe as in this country. The following table from *Cosmos* gives the number of kilowatt hours of energy per inhabitant sold in the year in the different large cities of the world:—

Chicago 425, Boston 400, New York 360, London 130, Buenos Ayres 123, Berlin 111, Hamburg 43, Paris 27.

AN ALBINO GOPHER SNAKE DISCOVERED IN CALIFORNIA

What is reported to be the second albino snake ever found, and the first ever caught alive and watched carefully for purposes of scientific study as to characteristics and habits, was given to Professor Storer, of the Department of Vertebrate Zoölogy, by a farmer who found it in the country near Berkeley, California. The snake is about the size of the ordinary gopher snake, but is marked by the entire absence of color. This peculiar reptile, which has a sort of fleshy hue with a bit of a pinkish tinge, is being closely watched by the members of the class who frequent the Museum of Vertebrate Zoölogy for any developments of unusual characteristics.

It is said that the German invaders of Belgium, whatever else they may have destroyed, have been careful not to injure park trees. The cavalrymen, so a report goes, are forbidden to tie their horses to trees for fear that the animals will gnaw the bark.

DEADLY AERIAL BOMB

Joseph A. Steinmetz, the Inventor of the Defensive Bomb, Demonstrating his Device which he Claims will be an Important Factor in Future Aerial Conflicts.

At the Left: The Defensive Bomb that is Swung from a Small Balloon and Explodes when Invading Aircraft Strike a Wire Attached to it. Above: The Offensive Bomb Used by Aeroplanes in their Attacks on Dirigibles. It Explodes when the Hooks Catch on an Airship.

The Water Mill Where the Water is First Utilized in Driving a Turbine Wheel. It is Connected by Cable to Wheel Downstream.

UNIQUE WATER MILL

A water mill in Western Ontario has the unique distinction of utilizing the water over again. After the water has passed under the mill's turbine wheel, it flows down the mill creek for a short distance until it comes to a tower. Passing under the tower, the water drives a wheel from which a wire cable is stretched across to a wheel on one of the mill walls. The cable thus drives the machinery with the water that has already been used further upstream.

After the Water has Passed Through the Turbine Wheel of the Mill, it Drives the Wheels of this Tower. A Cable Transmits the Power to the Mill.

"LIVE" RUBBER MEN MADE OF AUTOMOBILE TIRES

In a California street parade was recently entered a float bearing two monstrous men of "live" rubber automobile tires. These animated figures were forced to perform the most ludicrous "stunts" by means of compressed air, generated by an engine that was hidden in the body of the float. A system of valves, worked by two concealed operators, caused different parts of the anatomy of the rubber men to alternately extend and collapse with most striking results.

The float was an advertisement for a local tire supply firm.

A Float on which are Mounted Two Rubber Tire Men.

MEDICINE MADE TASTELESS BY NEW INVENTION

Who has not revolted against a dose of castor oil, rhubarb or other nauseous medicine? The placing of such drugs in soluble capsules was a great step toward making it possible to swallow without tasting them, but even so there are many people who cannot swallow a capsule.

An ingenious Frenchman has produced a cup that has been hailed as a boon to persons who have to take such substances as cod liver oil. He calls it the "pomponnette." When you drink your medicine from it, it gives you first some liquid that is pleasant to

the taste and to the smell. This is succeeded without interruption by the medicine, and this again by a delicious liquid, each flowing separately without the possibility of becoming mixed. Thus you have taken your medicine and have not perceived either its revolting taste or odor.

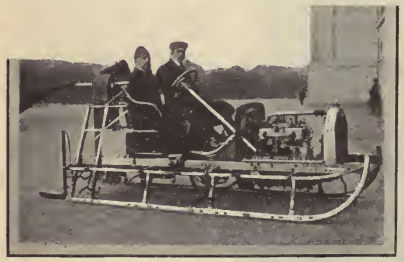
The pomponnette holds twice as much as the dose you are to take and it must be drained at one draught. However, there is no difficulty in this connection. It has three compartments, one above the other, the upper and lower containing the orange juice, wine or whatever pleasant liquid you may prefer. The middle one contains the medicine. The two partitions are movable and must be adjusted to rest upon the liquid so as to leave no air spaces. These partitions are pierced with oblique grooves that make it impossible for the liquid in one compartment to pass into another except by flowing horizontally. This prevents the liquids from mixing.

When you raise it to your lips, you drink first the contents of the upper compartment; when this is almost empty, the contents of the middle compartment begin to flow, and when this has gone, the lowest compartment gives out its contents in turn.

The pomponnette is being used commonly in France for administering doses of cod liver oil, which, to most persons, is one of the most nauseous substances taken as medicine.

A NOVEL MOTOR SLED

Motor-driven sleighs are no longer a novelty at the present time. But the type illustrated in the accompanying view presents many new features. It was built by an Austrian aeronaut who applied the method of propelling air-



Sled Driven by Aerial Propeller, Capable of Developing High Speed.

ships and flying machines to this vehicle.

In back of the body two large wings are mounted on a shaft that is connected with the engine. These wings serve to drive the sleigh. It is said that the vehicle starts up gradually and without shocks. The engine is placed in the front and develops 24 horsepower.

Another novel feature is presented in the method employed for guiding the sleigh. This is very much the same as the principle employed in steering a boat. Behind the runners are two large planes which touch the ground and are moved to the left and right by means of rods, levers and the inclined steering post. Two pairs of hooks, which may be pressed down into the snow through a foot pedal and a lever, serve as brakes.

In several trials in the vicinity of Vienna a speed of 25 miles per hour has been obtained on soft snow. On a hard snow surface almost double the speed has been developed. Still greater speeds have been attained on ice.

A FAMILY FOOTBALL FIFTEEN

A queer football team has been formed in England. It is composed of fifteen brothers who form a complete rugby team and have issued a challenge to any similar team. Needless to say, they will have a hard time finding any opposing team, as very few families of the present day contain fifteen children, let alone fifteen brothers, and when such a family is found it is doubtful whether they could all be persuaded to play football.

Odd Methods of the Orient

By Y. K. Weng.

GIVEN a problem of any type whatsoever to work out, the Oriental mind will arrive at a mental conclusion by a process of reasoning exactly opposite to that followed in a Western mind. The same rule applies to the methods used in accomplishing any particular task.

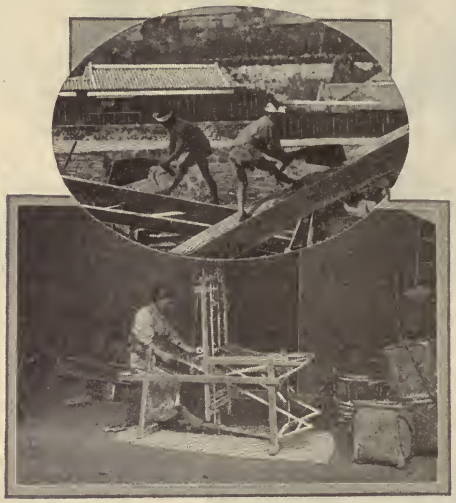
In China or Japan, a workman in removing a heap of stones or bricks or dirt will not carry one load the entire distance. Instead, he will carry one load

The Dexterity which the Tub Makers Obtain with their Feet is Astounding. At the Right: Common Sights Along the Yellow Sea Coast Towns are the Clumsy Rope-making Frames.

Above: A Primitive Rice Mill at Hankow, China. The Grain and the Chaff of the Rice are Separated by Numerous Ingenious Methods, all Employing Manual Labor to the Fullest Extent.

a short distance towards his destination and put it down. Then he will return to the pile, get a second load and place it alongside the first. He will continue in this way until the entire heap has been moved a step of the journey. Then he will repeat the manoeuver until, in time, the heap arrives at its destination by a series of short jumps.

Chinese or Japanese building construction methods also differ radically from those that are employed in this country. Instead of erecting an adjustable scaffold and raising it upward, floor by floor as the building progresses, he constructs an intricate bamboo network about the contemplated structure. In effect, the finished building is completely veiled until it is finished.



In the Oval: The Oriental Saws Cut on the Backward Stroke. Above: Hand Looms in Japan are Diminishing at the Rate of More Than One Thousand a Year.

An unusual form of tool employed in the Chinese and Japanese carpentry trade is the saw which is designed to cut on the backward instead of on the forward stroke, just contrary to the way saws are used in this country.

The lack of modern machinery of different sorts has compelled the Oriental manufacturer to devise numerous unique methods employing manual labor only. The making of wooden tubs is an interesting example of this. Whereas American tub and barrel machines turn out the finished product from crude lumber by a simple mechanical process, the Japanese method is painstaking and exceedingly tedious. The staves are cut and whittled to shape by hand, and the assembling is done by an ingenious manipulation of both hands and feet. The tub bottom is firmly grasped between the feet, and the staves are put in, nailed with wooden plugs and bound with the hands. The dexterity which the crouching workmen attain with their feet and particularly their toes is astonishing.

Ropes and halyards for the junks and sampans of the numerous rivers of China are made by a laborious process of hand weaving. A common sight in the coast towns along the Yellow Sea are the clumsy wooden frames for rope making. Several lines are stretched tightly between the uprights, and the ropemaker plies a tapering ebony or bone needle in and out among the cords until they are knit in a solid, even strand. Strange to say, these ropes can compare quite favorably both in strength and durability with Manila ropes. It is a fact worthy of mention in passing that the unpainted Chinese junks and sampans, although constructed without the use of a single metal nail, endure the buffets of the congested streams and the extremes of Chinese weather sometimes for more than a hundred years.

Rice mills are, of course, very primitive in Japan and China, although modern machinery for this purpose is being imported to some extent. Usually the grain is flayed by hand, and it is then ground by numerous ingenious methods. A common procedure is to erect a large bamboo tripod, suspend an inverted wooden cask from the angle and separate grain from chaff by pounding.

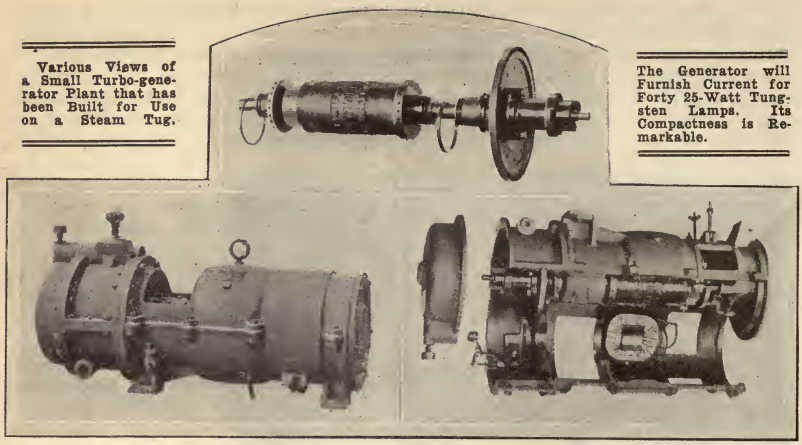
More than a thousand hand looms are being discontinued yearly in Japan with the importation of improved English electrically-operated mills. Thousands of the old hand looms, however, may still be seen in various parts of the Mikado's empire.

Executing a Pirate in Canton, China. Chinese Sampans Built Without the Use of a Single Nail. The Finished Building is Completely Veiled Until the Bamboo Lacework is Removed.

Chinese executions of public criminals differ radically from the hangings and electrocutions of America. There, a capital offender is decapitated. He is given a formal trial, and if his offence is of a serious enough nature, as murder or piracy, and he is convicted, his head is cut off with a sharp broadsword.

Experiences with forest fires in the national forests this year show that automobiles, where they can be used, furnish the quickest and cheapest transportation for crews of fire fighters. Motor rates are higher than those for teams for the actual time employed, but the total cost per distance traveled and in wages paid to men in getting to fires is much less. The time-saving is self-evident; trips which ordinarily require two days' time by team have been made by automobile in a few hours. The rapid arrival of the fire fighters often prevents dangerous fires from spreading.

Various Views of a Small Turbo-generator Plant that has been Built for Use on a Steam Tug.



The Generator will Furnish Current for Forty 25-Watt Tungsten Lamps. Its Compactness is Remarkable.

A TINY TURBO-GENERATOR PLANT

One of the latest wonders in the field of electric current generating apparatus is the tiny steam turbine equipment illustrated in the accompanying views. This equipment has been recently turned out by one of the leading electrical manufacturing firms for use on a small tug plying the waters of New York Harbor. It is said to be the smallest steam turbine equipment ever constructed for practical use. It measures 35⅛ inches in length, 18¾ inches in height and 13¾ inches in breadth. The electric generator of the outfit can supply current for forty 25-watt tungsten lamps, being rated at one kilowatt capacity. The only moving parts of the equipment comprise the rotor of the turbine and the armature of the generator. These are driven at a speed of 4,000 revolutions a minute; a centrifugal governor maintaining a constant speed.

This turbo-generator outfit fills a long-felt want in the way of electric light plants. Heretofore, a lighting plant for small vessels has necessitated devoting considerable space for installing the machinery. However, this equipment is so compact that it may be installed in a corner of any engine room without inconvenience. The weight of the equipment is but 405 pounds. Steam pressure at full load varies from 75 to 250 pounds per square inch.

REMARKABLE CHINESE PIGEON WHISTLES

Probably the most unique musical instruments employed in any country are the odd Chinese pigeon whistles. The accompanying view shows a pigeon with one of these whistles on its tail. The whistles are very light, weighing but a few grams, and are attached to the tails of young pigeons soon after their birth, by means of fine copper wire. When the pigeons fly, the wind blowing through the whistles sets them vibrating and thus produces a melodious open-air concert, for the instruments in a flock are all tuned differently. On a serene day in Peking, where these instruments are manufactured with great cleverness and ingenuity, it is even possible to enjoy this aerial music while sitting in one's room.

In spite of the seemingly large variety of pigeon whistles, there are but two distinct types: those consisting of oblong bamboo tubes placed side by side, and a type based on the principle of tubes attached to a gourd body or windchest.

They are lacquered in yellow, brown, red, and black, to protect the material from the destructive influences of the atmosphere. The tube whistles have either two or three, or else five tubes. In some specimens the five tubes are made of ox-horn instead of bamboo. The

on the principal mouthpiece, some arranged around it. These varieties are distinguished by different names. Thus, a whistle with one mouthpiece and ten tubes is called "the eleven-eyed one." Some have the shape of a pig's head.

As to the materials and implements

A Pigeon with a Chinese Pigeon Whistle, Showing the Method of Attaching this Musical Instrument. Chinese Pigeon Whistles, from the Simplest to the Most Complicated, are all Hand-made.

gourd whistles are furnished with a mouthpiece and small apertures to the number of two, three, six, ten, and even thirteen. Certain among them have, besides, a number of bamboo tubes, some

used in the manufacture of pigeon whistles, there are small gourds that serve for the bodies, halves of large gourds—a particular species imported from Shantung to Peking for this spe-

cial industry—from which stoppers are made that fit into them, and four kinds of bamboo: cylindrical pieces of a large species that grows in the south, used in making the mouthpieces of the large tubes; thin sticks for making those of the small ones; hard bamboo for the large tubes themselves; and a soft kind for the smaller ones. The separate pieces are fastened together by means of fish glue applied with an iron nail One workman is said to be able to turn out about three specimens a day, indicating that the work requires some time and skill.

A MAMMOTH ELECTRIC ADVERTISING SIGN

The latest electric advertising sign erected by the Commonwealth-Edison Company of Chicago is located on top of a building at Michigan Boulevard and Randolph Street.

This sign is claimed to be the largest motograph in existence.. It measures 130 feet in length and 50 feet in height. The moving letters are 12 feet high and may be read nearly a mile and a half away. Every night a different legend appears on the sign extolling the virtues of electricity and of electrical appliances.

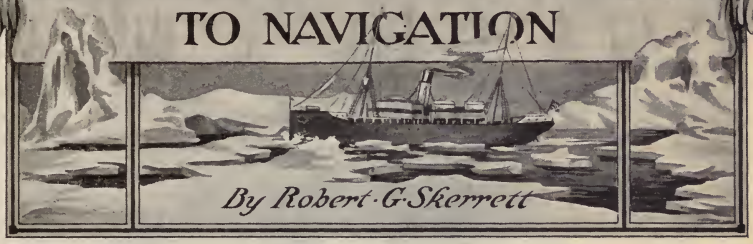
WORLD'S LARGEST CHEESE 25 FEET IN CIRCUMFERENCE

The world's largest cheese has just been finished at West Martinsburg, New York, and will soon be shipped to the World's Fair in San Francisco. It is four feet seven inches high and 25 feet around. One hundred and six thousand pounds of milk were required to make this gigantic cheese.

A Huge "Talking" Electric Sign that is being Employed in Chicago for Advertising the Advantages of Electric Light and Power.

The town forest of Baden-Baden, Germany, yields an annual profit of $5.25 per acre, or a total net profit of nearly $67,500. Germany is an exponent of advanced forestry.

OPENING ICE-BOUND WATERS TO NAVIGATION



By Robert G. Skerrett

WHATEVER be the outcome of the war in Europe, whether it give to the Czar an open port to the outer world by reason of added territorial possessions, Russia may confidently look forward to a commercial revolution in that her trade routes to the seas beyond need not hereafter be hampered by barriers of ice. At least, that is the promise of an American inventive genius—a man who has already startled us by his amazing mechanical achievements. We refer to Elmer A. Sperry, who has found so many helpful uses for the gyroscope.

It is probably an old story to you that Russia has longed for many decades for a port on open waters in the winter time; a harbor that she could control and which would lead directly to the free seas. Politically or strategically, call it what you may, her outlets on the Black Sea are not unrestrained because there is the ultimate passage through the Dardanelles guarded by Turkey. In the north, her Baltic ports serve well enough in summer time, and so does Archangel on the White Sea, but then comes that long interval when Jack Frost grips these waterways and makes navigation well nigh prohibitive. Again, in time of war, there is the vexing problem of Denmark's neutrality, and the Danes hold the keys to the western gateways of the Baltic. True, Archangel is entirely under Russian dominance, but the open period normally for that far northern port is scarcely more than three months in the summer time, and then the Arctic ice gathers in the White Sea and builds a pretty effectual bulwark against the activities of shipping.

These are apparently insurmountable obstacles, and yet Mr. Sperry says they need not be, and he promises to overcome them by means of the gyroscope. This sounds decidedly fantastic, and yet there is a substantial basis of fact and accomplishment upon which to build this prophecy. However, before we give the details of Mr. Sperry's plans and his arrangement with the Russian Government, it is needful that we know something about ice conditions in the Baltic and the White Sea, and recall what has already been done in the way of efforts to battle with the barrier floes.

The "Ashtabula," One of the Big 5,000-Ton Car-Ferry Steamers Employed on the Great Lakes.

When Japanese mines sank

one of the Czar's battleships outside of Port Arthur, the Russian navy lost its foremost scientist, Admiral Makaroff. Happily, some years previously, he devoted his engineering skill to the design-

drive of her 10,000-horse-power engines was expected to crush the opposing floes. Admiral Makaroff planned and builded well, and her performances confirmed the Admiral's expectation. The vessel was

Two Instances of Steamers Caught in Ice Jams and Obliged to Remain Inactive for a Considerable Length of Time.

ing of an ice-breaker, and from his plans there was built that notable craft of 8,000 tons, the *Yermak*. The ship was structurally of somewhat unusual form and exceptionally strong. She was meant to force her sturdy bluff bow up and on the ice, and by sheer weight and the forceful

really built for service in the Kara Sea, which is practically ice-bound the year through, and preliminary to dispatching her there she was given a rigorous trying out on an experimental run to Spitzbergen against heavy polar ice.

At times, the *Yermak* was rushed di-

rectly against polar ice 14 feet thick, but the floe cracked sharply under the attack—showing the tremendous momentum of the assaulting craft. As a result of some weeks of bumping around in the neighborhood of Spitzbergen Admiral Makaroff brought out the fact that the prime essential for an ice-breaker in that region was hull strength and not necessarily engine power. On the other hand, when tried out in the Baltic, the conditions were quite reversed. Not that the body of the ship need not be very strong—for that is necessary of course—but effective work hinged more upon the available horsepower of the propelling engine. Admiral Makaroff also found the fresh-water ice in the Baltic to be stronger than the salt-water ice in the Arctic Sea; but where the Arctic floes split in long cracks the Baltic hummocks and drifts were shattered into a hampering clutter immediately about the *Yermak* and at the point of attack.

The Simple Toy Gyroscope—the Principle of which is Applied for Opening Ice-bound Waters to Navigation.

With the Arctic ice the cleverage readily opened up a clear way through which the ice-breaker could push, but the friable Baltic ice behaved in another way. Let us quote from a report made by this notable authority. "When the ship charges into it, it does not form long cracks, but breaks under her. When the ship passes half of her length in such a floe, she touches so many fragments that they stop her progress by their friction and pressure upon the craft's plating forward. When the ship stops, there is no other way than to back and charge again. This time, before the bow of the vessel touches solid ice it has to run through a hundred feet or so of broken ice. That diminishes very much the speed of the boat, which, on a second charge, may make very little headway. It happens sometimes that after the ship stops going ahead it wont go backwards, and it may take half an hour and the alternate working of the engines ahead and astern before she can be got free."

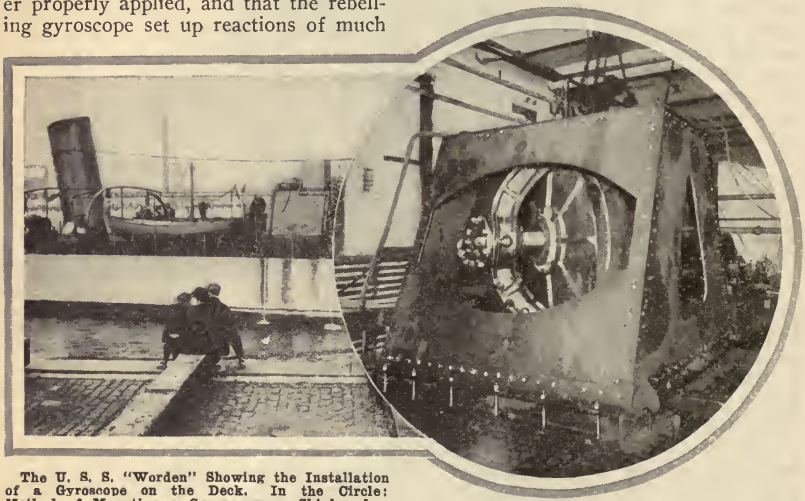
The ice-breaking problem has been with us for many years in America, and on the Great Lakes navigation is kept open for weeks in the late fall and started early in the spring by means of certain little tugboats that are able to break paths open for the big car ferries and other large steamers which cannot do this for themselves, strange as it may seem.

As we shall see, it is not always best to follow the advice of that popular song, "Sit down, sit down, sit down you're rocking the boat!" The small tugs in question are purposely designed to rock, and by this rocking motion they deal sidewise blows to the ice while their propellers are forcing them steadily forward through the broken pieces and at good speed against the solid edge of the floes or hummocks. These tow boats have abnormally big rudders worked by steam steering engines, and this sculling motion rolls the little craft from side to side. Big steamers would do the same thing if so equipped, but the cost of such an installation would be prohibitive. Now we come to Mr. Sperry's solution, for he makes it possible for any vessel to break her own way and all because of her capacity to

roll rhythmically under the impulse of suitable gyroscopes.

We are not going to elaborate upon the workings of a gyroscope, because most of us know enough about this form of the spinning flywheel to recall its obstinate tendency to revolve in a given plane or forcibly to resist external efforts to disturb it in its chosen path. Now Mr. Sperry went further than this, for he showed that the gyroscope could be swung at will first to one side and then to the other side of this chosen path by means of a moderate application of power properly applied, and that the rebelling gyroscope set up reactions of much greater moment or force than the power required in the disturbing apparatus. In other words, he found a way to stabilize a torpedo boat by merely swinging a gyroscope spinning in a vertical plane to one or the other side so as to neutralize the upsetting impulse of a wave. The bigger the wave the more the gyroscope was turned to oppose it. Instead of shifting a large weight from port to starboard on the boat's deck, the mere movement laterally of the pivoted gyroscope answered the purpose.

The aim in the case of the U. S. S. *Worden* was to stabilize the craft so that she would ride steadily upon a troubled sea. Just the same, it was discovered that the boat could be rocked vigorously when lying in still water by the arbitrary turning of the stabilizing gyros. Learning how the little tugs broke the ice on the Great Lakes, Mr. Sperry proposed to install a gyroscopic stabilizing plant on one of the big 5000-ton car-ferry steamers, so that the same equipment could be used to steady the vessel in rough weather or to rock her when seeking to break her own way through the ice floes. Hearing of his perfected plans for the steamer *Ashtabula,* the Russian Government was at once interested. Up to a point Admiral Makaroff's *Yermak* had proved practical, but, as has already been explained, even that powerful vessel had the greatest difficulty in plowing through the Baltic ice because of the manner in which she was held or gripped by the broken fragments.



The U. S. S. "Worden" Showing the Installation of a Gyroscope on the Deck. In the Circle: Method of Mounting a Gyroscope on Shipboard.

It was clear that an ice-breaker provided with self-rocking power would be able to do far better work, and a ship of 8,000 tons fitted with the Sperry gyroscopes would have it in her power to deal staggering lateral blows to the surrounding ice. While her rolling motion freed her from the grip of these fragments her engines would drive her with all their energy forward against the barrier—thus alternately breaking, crushing, and get-

ting clear of the gathering debris. Accordingly, Mr. Sperry has under way designs for this very service, and he says that it will be possible for him to furnish the required installation upon a moderate weight of not more than two per cent. of the total displacement of the craft carrying it. This is really remarkable, because other stabilizing methods call for a much heavier sacrifice and even then do not compare in efficiency. The beauty of the arrangement is that the same apparatus that rocks the ice-breaker can steady her when that is desirable.

A Huge Great Lakes Steamer Caught in the Ice Pack During Severe Winter Weather.

With her Baltic ports kept open in this manner during winter time, it will make it possible for Russia to maintain her oversea commerce uninterruptedly. But what she can thus do in the Baltic, Russia can repeat in the White Sea and along the northern coast leading out into the Atlantic. Archangel, which commonly is open to navigation from July to September only, can be made a free port the year through. The commercial significance of this must be apparent without further elaboration here.

There is a scientific interest besides in what Mr. Sperry's invention promises to make effective in the name of trade. When Admiral Makaroff carried the *Yermak* into the Arctic Sea on his experimental ice-breaking trial trip to Spitzbergen, he then conceived the startling plan of reaching the North Pole by means of a kindred craft especially strengthened to battle with the heavier obstacles to be met in such a venture. We know that the unfortunate *Karluk,* as other polar exploring steamers, was caught in the ice and carried irresistibly to her doom. An ice-breaker modeled somewhat after the broad design of the *Yermak* and provided with rocking gyroscopes might reasonably be indifferent to such circumstances, and whether the objective be the Pole or not, still a ship of that character might greatly facilitate Arctic investigations and serve other essentially practical ends in those waters.

For once, there is a goodly measure of sanity in being able to rock a boat at will, and out of the toy top has evolved an instrument, thanks to Mr. Sperry's skill, capable of battling effectively with Nature in both her angry and her grimmest moods. In effect, he stills the tumbling seas and he cleaves the frigid bulwarks that have so often balked the mariner or crushed his ship.

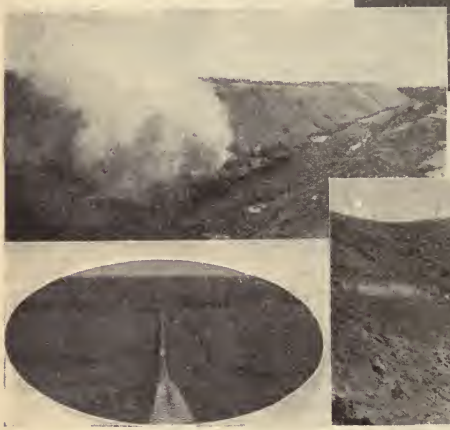
IRRIGATION CANALS FOR ALBERTA'S DRY BELT

One of the greatest irrigation projects designed to effectively redeem an enormous acreage of otherwise waste land is that of the Southern Alberta Land Company. Some 400,000 acres are owned by the company in the Canadian province, of which one-half is regarded as irrigable. The location is in the vicinity of Suffield on the main line of the C. P. R. The water diverted from the Bow River to supply the system of canals, reservoirs and laterals, enters the main intake at a point about thirty miles east of Calgary and forty miles west of the celebrated Bassano dam. The total distance of artificial waterways is 170 miles, excluding reservoirs. Some remarkably long flumes have been constructed, one being 5,000 feet and crossing the "Mile-Wide" Valley. Across one of the creeks encountered on the route is an inverted syphon consisting of a pair of wooden stave pipes, each 7 feet 6 inches in diameter and 1,047 feet long. From the intake

to the first storage reservoir is 45 miles. The main reservoir runs north and south and is the most important piece of construction in the whole scheme. It is formed in a dry coulee, 21 miles long and at the widest part about 12,000 feet across, narrowing down to about 2,000 feet between precipitous banks towards the southern end. The maximum capacity of the reservoir will be about 300,000 acre feet.

Views of Alberta's Gigantic Irrigation Work

Views of the Bassano Dam Forming Part of a Reservoir that will be about 3,000 Acre Feet when Completed.



Views of the Extensive Engineering Work as well as One of the Numerous Flumes.

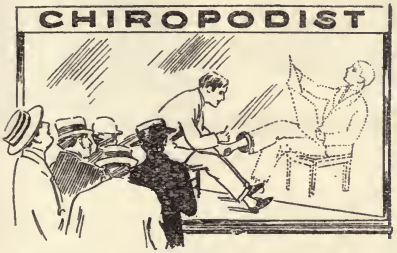
Outside of its use for fence posts, black locust finds its principal utilization in insulator pins and brackets for telegraph and telephone lines.

UNIVERSITY COURSE IN NEUTRALITY

The University of California now offers among its many extension courses a class in the neutrality of the United States and its citizens during the present European struggle. This is conducted under the direction of the division of University extension, and is under the immediate supervision of the department of international law. This is one of the many interesting developments in college curricula as a result of the war. This course has aroused great interest and probably other colleges may follow suit.

A PECULIAR WINDOW ATTRACTION

A chiropodist in a western city occupies the window of a prominent barber shop, making his appeal to men only. The window is partitioned off both front



A Western Chiropodist treats His Customers' Feet in Full View of Passers-by.

and back with heavy curtains. In the front curtain there is a hole for the customer to stick his foot through. By plying his trade in full view of the public he demonstrates his ability to do expert work in a sanitary manner. The publicity gained, together with reduced prices for the work, brings him plenty of patrons.

AN UNUSUAL BUT EFFECTIVE GARAGE SIGNAL

An interesting bit of "Safety First" work has been put in practice by the proprietor of a garage in Louisville, Kentucky, whose example might well be followed in other places.

Motor vehicles leaving this garage are obliged to cross the sidewalk of a busy street along which pedestrians are passing at all hours of day and night, and as a warning a lamp has been installed in front of the exit in a large globe, on each side of which the word "Danger" is painted in large letters.

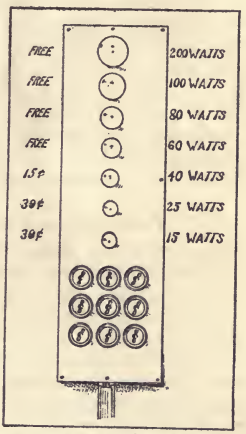
This lamp is lighted from sunset to sunrise and in itself forms an effective cautionary signal. It is, however, supplemented by a loud-ringing gong, which is automatically operated whenever a vehicle approaches the exit door; a steel plate being so placed that it automatically closes the contact with a copper spring and rings the bell whenever the wheels pass over it.

Reports state that it is interesting to note how pedestrians passing along the sidewalk intuitively "stop, look and listen" at the instant the bell begins to ring and wait until the automobile has crossed the sidewalk into the street. It has been suggested that local authorities would do well to enforce the installation of such a device at the entrance to every garage located on busy thoroughfares.

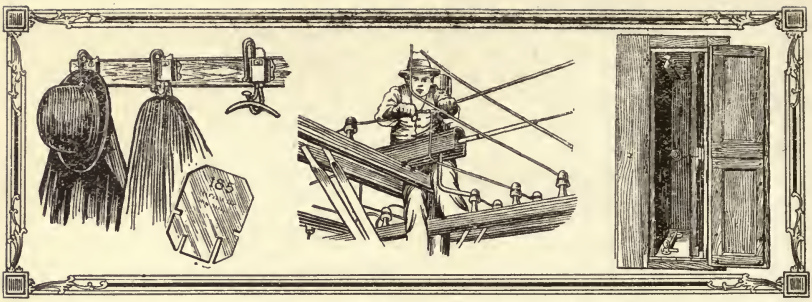
A PRACTICAL ELECTRIC LAMP DISPLAY

An electric company of Hartford, Conn., has placed a board in the retail office which shows vividly the scale of prices for lamp renewals. The lights on the sign vary in size from five hundred to fifteen watts, and opposite each one is the price for a new one. The clerks found that it was difficult to pursuade the public that the bigger lights were sold at a cheaper rate than the smaller ones. It frequently took five or ten minutes of valuable time to convince a patron that the scale was right. Now they see at a glance and believe their eyes.

The box is seven feet long and three feet deep, of painted pine boards, as shown. Snap switches at the bottom control each light. The device was built by the clerks and not only serves its purpose, but is also a good advertising medium.



A Novel Electric Light Price List.



Coat Checking Device. Protective Device for Linemen. Electric Incubator Control.

New and Improved Devices

Coat Checking Device

An ingenious coat and hat checking device has recently made its appearance in the novelty market. The device consists of a series of coat hangers above each of which is placed a locking member that prevents the coat and hat being removed from the hanger once the check, which constitutes a key, has been removed.

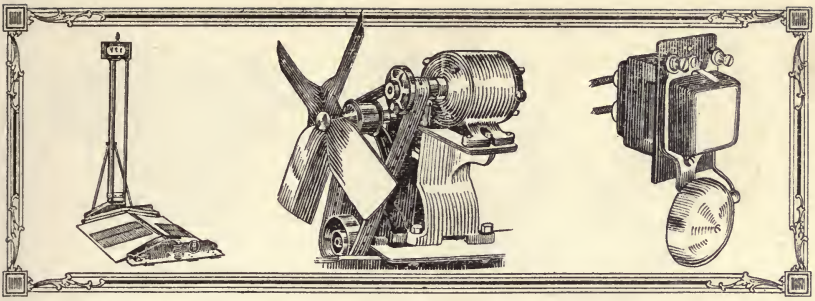
The system should find a ready field in the lobbies of hotels, in restaurants, theatres, and other places where the public gather and where the "Watch your hat and coat" signs offend the eye at every turn. The system will also dispense with the necessity for an employee in the usual check room in small places where this expense is not justified.

Protection for Linemen

A new device intended to afford protection for linemen against dangerous shocks through contact with high voltage wires has recently been introduced. The device is a rigid shield of heavy rubber composition, which rests on the cross-arm and encloses the conductor, leaving a three-inch air space on all sides. The shield is made of an inverted U section thus allowing it to be quickly placed over the wire which is slipped into end sockets holding it securely in place so that the guard cannot be loosened by wind or through contact with the lineman's body. The cross-arm on which the shield rests, bears all the weight and the shield does not come in contact with the wire at any point throughout its length. An additional protection is afforded through the use of slotted flexible tubes adapted to be slipped over the conductors. These tubes are furnished with the shields and the latter can be supplied in successive sizes, making it possible to "nest" them in order to economize on space in transportation.

Electric Incubator Control

Through an ingenious arrangement of its three electric circuits, a new electrically-heated incubator effects a wonderfully perfect control of its temperature. The first of the three circuits serves to raise the temperature approximately to the desired point. At this point a thermostat is operated and a second circuit in series with the first is put into operation, tending to maintain an even temperature. In this circuit are one or more lamps which may be lighted by pressing a button when it is desired to examine conditions in the incubator chamber. A third circuit, operatively connected with the second circuit by means of a thermostat, is put into operation in case of any increase in the voltage of the electric current that might tend to raise the tem-



Truck Counter. Automobile Lighting Generator. Compact Bell-ringing Transformer.

perature to a dangerous degree. The resistance of the latter circuit is such as to lower the temperature of the incubator chamber so that the latter is held to an even temperature without endangering the hatch through fluctuation.

In one of the accompanying illustrations may be seen the thermostats at the sides of the incubator chamber and the wires which are heated to raise the temperature are disposed over the top of the chamber.

Truck Counter

An ingenious machine designed to automatically count truck loads of merchandise is shown herewith. It is claimed that where any considerable amount of shipping is being done, the truck counter will frequently save its cost in a single day through the elimination of errors that inevitably creep in where the usual method is employed. The counter is so made that when the truck rolls on to the apron, the weight of the truck load presses the apron down, the truck wheels move the lever forward and the load is tallied. As the trip lever moves forward, it also goes down, and with it the narrow apron; therefore the platform becomes so nearly level that no resistance is offered to the trucker. As the truck passes off of the machine, the latter is instantly set for the next load. The machine cannot be tripped by the weight of the men pushing the truck or by returning with either an empty or a loaded truck.

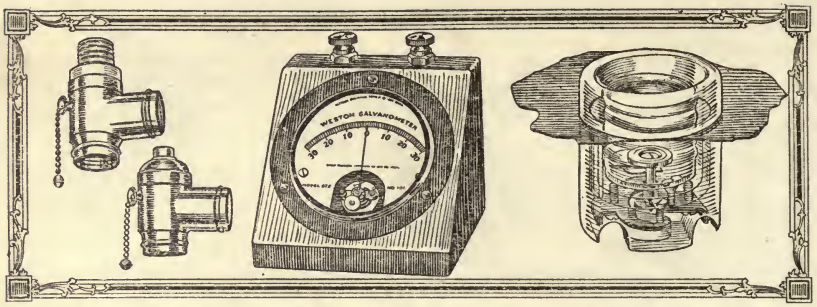
Lighting Generator for Light Car

An ingenious belt-driven lighting plant for light cars is shown in the accompanying illustration. The belt is perforated with a series of holes which engage with spurs on the pulley of the generator, thus insuring certainty of drive even though the pulley be of small diameter. The complete drive is the equivalent of a leather chain which adapts itself perfectly to the sprocket on the generator shaft as well as to the plain pulleys on the fan and crank shaft.

The generator can be placed on most cars as shown in the illustration, a triangular drive idea being employed. The requisite speed for the generator, from 1800 to 2000 revolutions per minute, can be obtained without the use of an inordinately large pulley on the engine shaft because of the small pulley diameter made possible on the generator shaft by means of the spur drive.

Compact Bell-Ringing Transformer

A combination of an exceedingly compact bell-ringing transformer with a flush plate adapting it to be fitted into any standard single-gang switch box is shown in one of the accompanying views. The transformer is adapted for use in residences where it is desired to place the transformer near the bell. The plate, to which the transformer is attached, is drilled to fit any standard iron box bell. It will also take a flush switch plate where it is desired to make the finish correspond to the finish of the hardware



Twin Pull Sockets. Compact Student's Galvanometer. Sign Receptacle.

in the installation. The transformer is given a drastic high voltage test for insulation faults and is designed for operation on 110-volt, 60-cycle circuits with a secondary potential of 10 volts.

Twin Pull Sockets

Pull sockets with outlets for two lamps have recently been introduced. An attachment plug, of course, may be substituted for one lamp or two attachment plugs may be used instead of two lamps. The socket is made in two types. In one type both outlets are simultaneously put "on" or "off" by successive pulls of the chain. In another type, the straight outlet alone is affected when the chain is pulled, the lamp in the angle being "on" all the time. The first type is useful where it is desired to turn on and off two energy-consuming devices at the same time or where one outlet holds a lamp which is used as a pilot lamp for an appliance connected to the other outlet. The second type is useful when it is desired to have a lamp or other energy-consuming device equipped with its own switch connected to the angle outlet. A shade holder can be attached to either outlet and can be held in its normal position relative to the lamp.

Student's Galvanometer

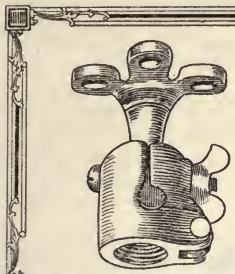
A portable galvanometer designed to meet the requirements of students in high school laboratories has recently made its appearance on the market. It is particularly adapted to the use of science instructors as a portable instrument of great durability, reasonable sensitivity and moderate cost. The galvanometer is mounted on a base at an angle of 45 degrees so that the face is inclined to a position in which the reading may be taken most conveniently. The base of the instrument is 3½ inches in width and the total height including binding posts is 3½ inches. The scale is 2.35 inches in length, is uniformly divided and is calibrated 30-0-30. A zero adjusting device is provided.

It is claimed that in action the galvanometer is extremely responsive and well damped; indeed, it is said that on dead short circuit it is periodic.

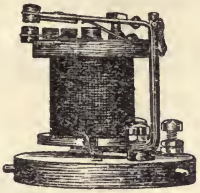
New Sign Receptacle

A sign receptacle of interesting design has recently been offered to the trade. The receptacle goes into 1⅜-inch hole and requires no lug or slot to prevent it from turning. It is prevented from turning by three fins on the front portion of the porcelain, which bite into the sheet metal of the sign as the two portions of the receptacle are brought together with the center screw. The latter does not come into direct contact with the center contact of the lamp and there is accordingly no tendency for the screw to loosen by friction of the lamp on the screw-head.

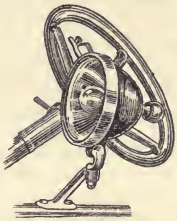
The entire front portion of the receptacle can be removed and replaced without disturbing the line connections



An Adjustable Hickey.



Automatic Cut-Out.



Automobile Spotlight.

Since the receptacle goes into a perfectly smooth hole, it can be set in any desired position and then be positively prevented from turning by tightening the center screw.

"Hangstrait" Hickey

The hickey shown in an accompanying view should be a boon to the electrician who installs fixtures on ceilings. How many times is a chandelier found to be out of true after the crow-foot has been attached to a crooked stud or a drop that is out of the perpendicular? And even assuming that good workmanship has provided a good, level base upon which to screw the crow-foot, a crooked thread on the end of the fixture pipe will produce the undesirable twist in the fixture.

The new hickey obviates all of these annoying difficulties. It consists of an adjustable, malleable iron ball-and-socket joint of great mechanical strength. The wires are brought straight through an opening larger in diameter than that of the pipe to which the hickey is attached, hence there is no straining of the wires. The hickey is low in price and neat in appearance and it would seem that the many advantages presented through its use should justify its employment in practically every case where a fixture is to be hung. The hickey is made in a variety of styles with outlet box studs, crow-foot or tripod, or to fit insulating joints.

Automatic Cut-Out Device

A compact and serviceable automatic cut-out has recently been placed upon the market and it should find ready favor among autoists and motor boat enthusiasts. The cut-out is designed to protect the storage battery by making the circuit when the generator is running at the proper speed and breaking it when the generator stops or its voltage falls below the normal value required to charge the battery. Thus it prevents the discharge of the battery back through the generator when the low-voltage point is reached.

Spotlight for Automobiles

Spotlights are becoming quite a fad among motorists. They are especially convenient for spotting out guide boards, house numbers, and the like, at night or for following the sharp angles of mountain roads that cannot be seen by the rays of the stationary headlight. A very convenient light of this kind has recently been perfected. It is swung on a perfect universal joint, enabling the driver to throw the light at any desired angle. The light is made with attachments by means of which it may be secured to almost any part of the automobile or motorcycle.

Gasoline Substitute Is Given Official Test

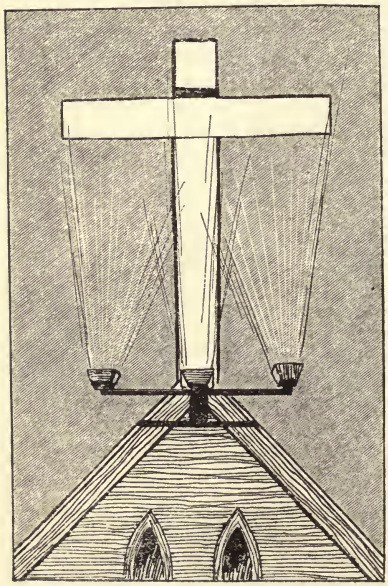
A few days ago an official test was given to zoline, the new substitute for gasoline. A stock Marmon car using this product for fuel was driven for one

thousand miles at a speed of fifty miles an hour on the Indianapolis speedway under the auspices of the Automobile Association of America. The results of the trial run are said to have been entirely satisfactory and apparently this test proves the practicability of the new fuel It is said that there was a surprisingly slight deposit of carbon on the cylinder heads and the pistons and that what little carbon was found was soft and quite easily removed.

It is claimed that the new substitute for gasoline can be made for 1½ cents per gallon.

A Novel Lighting Effect

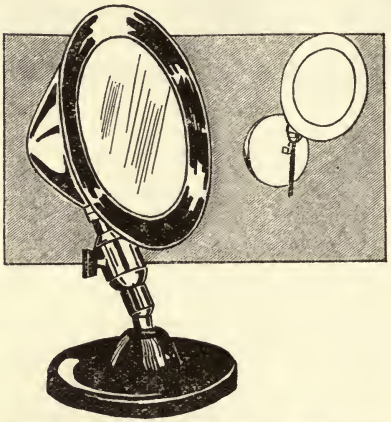
A novel idea has been employed in lighting a cross on a church in a Western city. The cross is painted white and incandescent lamps are arranged in reflectors on both sides of it in such a manner that when the lamps are lighted, their rays will fall upon the white cross, thus causing it to stand out boldly in the darkness. The reflectors are so adjusted that the point of light in each is completely hidden from the view of spectators in the street.



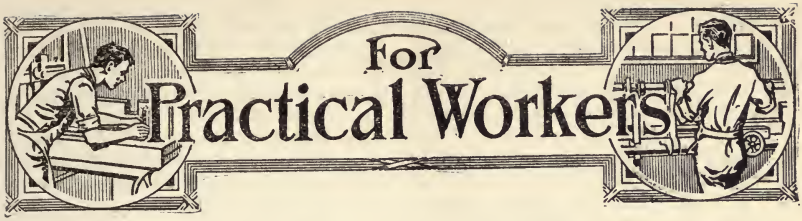
A Novel Method of Lighting a Cross on a Church Top. The Cross Stands Out Prominently against the Dark Sky.

A New Portable Lamp

A new and unique development in portable lamps is shown in the accompanying illustration. It consists of a circular mirror, a metal reflector, a lamp socket, a silk cord and an attachment plug. The socket is mounted directly on the base by means of a hinge joint that permits of the adjustment of the lamp and reflector through a wide range of angles. The six-inch mirror is supported by three clips, flushed with the opening of the reflector. The mirror is surrounded by an open space through which the light is diffused. This lamp was originally designed for the man who shaves himself. With one adjustment it illuminates all parts of the face—under the chin and both cheeks. However, after the clips have been released and the mirror removed, advantage can be taken of its adjustable features by using it on a sewing machine, the piano, or the writing desk. The device also makes a very convenient reading lamp. A lug on the base provides for hanging it on the wall when so desired.

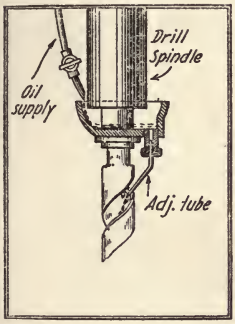


A Portable Lamp of Pleasing and Efficient Design, which May Be used on Table and Wall.



Oil Feed for Drill Press

On a press using taper shank drills, an oiler to lubricate the drill points can quickly be rigged up out of parts usually found around the shop. The main part is the oil cup. In this case the steam chamber from an old 1¼-inch steam whistle was employed. The threads were bored out and the hole tapered to slide down to within ⅛-inch of the large end of the largest sleeve used on the press. A block of brass shaped to the curve of the cup was sweated on and drilled and tapped for ¼-inch pipe thread. A short ¼-inch nipple with a valve packing nut on one end was screwed into the cup. A short piece of ¼-inch outside diameter copper tubing curved to lie in the flute of the drill is pushed in the nipple and the packing nut tightened to hold it in position. By using the packed joint the feed tube may be adjusted to feed oil into the flute of any drill from ½-inch up to the largest. When using drills with same number of taper as the spindle the cup is placed directly on the drill shank. As the oil follows the flute of the drill down to the point and lips, this method is much cleaner and more economical of oil than when the latter is squirted on with a can.



Contributed by

JACK ROACH.

Dark Room Lantern

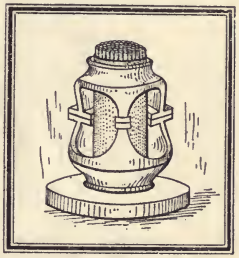
For one who has electric lighting current at hand there is perhaps no handier dark room lantern available than one made from a 25 cent candle lamp of the folding variety with a hole punched in one of the metal ends through which the base of the bulb is screwed. Such a lamp with the bulb removed, of course, can be packed in a very small space and in consequence is ideal for the traveler.

Contributed by

EDWARD F. HALLOCK.

A Novel Match Stand

The reader will probably see at a glance that the essential parts of this stand are the holders of two inverted mantles. A piece of fine sandpaper is wrapped around a wooden roller and then glued up to form a tube which fits the inside of the mantle holders. A base is made from a disc of wood and the various parts assembled with glue. The wooden roller is of course removed in order that matches may be placed inside the tube of sandpaper. When the glue is dry the holder may be filled with matches and it is obvious that they are to be scratched on the wall of the sandpaper tube through the openings between the legs of the gas mantle holders.



Contributed by

J. NELSON HILL.

China Insulating Handles

The china handles used on certain types of faucets are very useful articles to have around when constructing electrical apparatus. They present a neat

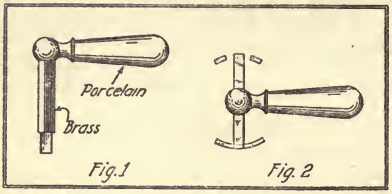


Fig. 1 Fig. 2

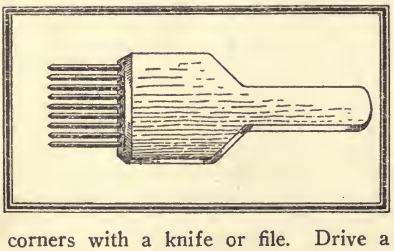
appearance and possess good insulating qualities. Such handles can be found on the scrap pile at almost any plumbing shop and can be purchased for little or nothing. Fig. 2 shows the working part of a 3-point switch made from such a handle by soldering a flat strip of brass at right angles to the stem. In the switch referred to the current carrying parts were all beneath the apparatus table in a wireless station, only the handle projecting above. Where the stem passed through the table, a hard rubber bushing was used.

Contributed by

H. W. Smith.

Nail Picker

Take a piece of pine board or any other soft wood six inches long and four inches wide and shave it to a shape not unlike a butter paddle, leaving the broad end about an inch thick. Trim the long



corners with a knife or file. Drive a row of ten penny finishing nails into the end of the broad part near enough together to let the shank of a six or eight penny nail enter, but not far enough apart to permit the heads to pass through. File the heads of the nails down to points.

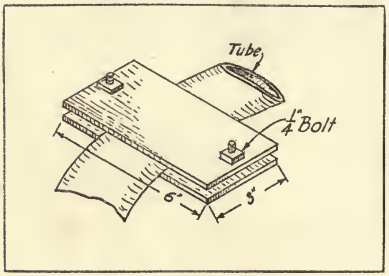
This makes a device that is very handy and serviceable to the box maker or anyone who has much bench nailing to do. A few jabs into a box of nails and it will gather a hand full of them, heads all one way and ready to be taken off, thus saving the time and trouble of turning them in the fingers as they are fed to the hammer.

Contributed by

Theodore Wilson.

Tire Patch Clamp

A handy inner tube patch clamp for the tubes of bicycle and motorcycle tires may be made by bolting together two



3 by 6 inch pieces of iron as shown in the accompanying sketch. The holes in the under piece should be a snug fit for the shoulder of the bolts, while those in the upper piece should be an easy clearance fit. It is preferable to employ wing nuts on the ends of the bolts in order that no wrench may be necessary for tightening.

Contributed by

Francis W. Nunenmacher.

Protecting the Edges of a Flag

To prevent a flag from becoming frayed at its edges it is only necessary to run a fine copper wire around it. This will prevent the flag from waving in sharp and snappy jerks that result in ripping the edges.

Contributed by

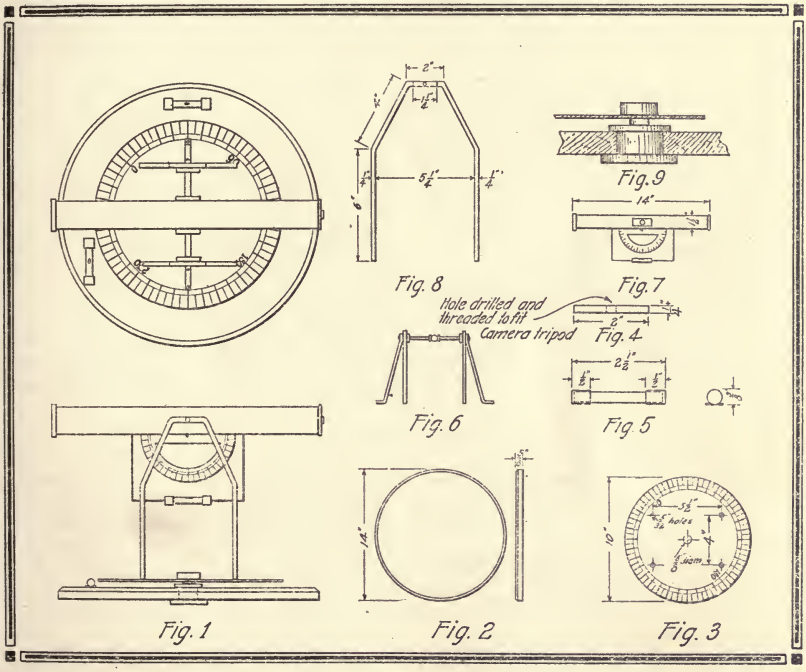
Edmond Von Kaenel.

CONSTRUCTION OF A PRACTICAL SURVEYOR'S TRANSIT

By R. L. Kenyon

A transit that will comply with nearly every necessity may be constructed by the handy man at a nominal expense. The material needed will be an oak disc 14 inches in diameter and ⅝ inch thick, a brass disc 10 inches in diameter by ⅛ inch thick, a piece of 1½ inch brass tubing 14 inches long, a 5 inch protractor, 6 feet of ¼ inch square brass rod, four brass ferrules and some glass tubing to fit in the latter.

tion is to calibrate the brass disc by dividing it into 360 degrees. It will be a saving in time and money to have a machinist do this on a milling machine, since it will take him but a short time and the charge will be very slight. The machinist should be instructed to make every 5th line come into the 3rd circle and every 10th line come in a little further as shown in Fig. 3. When this has been done every 10th division may be stamped with steel numeral dies as



The oak disc should be turned true on a lathe and centered. With reference to Fig. 3 in the drawing the holes may be drilled in the piece of sheet brass as indicated and the brass disc fastened to the wood with small screws, making sure that the centers of the two discs coincide. The next operation is to calibrate the brass disc by dividing it into 360 degrees. It will be a saving in time and money to have a machinist do this on a milling machine, since it will take him but a short time and the charge will be very slight. The machinist should be instructed to make every 5th line come into the 3rd circle and every 10th line come in a little further as shown in Fig. 3. When this has been done every 10th division may be stamped with steel numeral dies as 10, 20, 30, etc., on up to 370. The surface may then be smoothed off with a scratch brush or coarse piece of emery cloth, finishing off with fine cloth and finally lacquering.

The square brass rod is to be cut and bent into the shape shown in Fig. 8, and two short lengths of the rod are

cut and both are secured to the supports at the top as shown in the drawing. The blocks may be secured either with machine screws or by riveting. A hole should be drilled through each of the pieces and on through the support and tapped for an 8-32 machine screw thread. A hole should also be drilled in the bottom of each leg and tapped with the same thread. Two pieces of rod should be bent to the shape of the braces shown in Fig. 6 and secured in position.

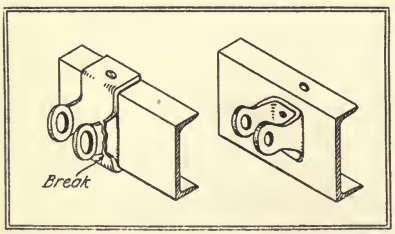
The brass tube should next be fitted in place. A short piece of the square brass rod is fitted to each side of the tube and a hole is drilled in each of these pieces, care being taken to see that the holes are diametrically opposite. Two short pieces of 5/32 inch round brass rod are threaded at one end with an 8-32 die in order that they may be fitted into the holes in the top of the supports shown in Fig. 8. They should be of such a length as to support the tube over the center of the disc when the parts are assembled. A cross composed of two pieces of No. 36 copper wire should be soldered in each end of the tube. The tube is completed by soldering the protractor to the underside as shown in Fig. 7. If the extra refinement of a level is desired it may be affixed as shown in the drawing.

A two-inch disc of brass is fastened over the center hole in the oak disc and precisely in the center a 5/8 inch hole is drilled and tapped. A couple of copper burrs are placed over the hole and the upper disc bolted down so as to be firm and yet free to revolve. The two levels are attached to the oak disc and an index to read on the horizontal protractor is placed in position. A socket fastened to the underside of the oak base to fit a camera tripod completes the job.

The zero readings should be checked so that when the tube level is horizontal the reading on the small protractor is zero. If desired the two may be fitted with telescopic lenses and in that case the cross hairs of fine wire should be placed at the foci of the lenses. The cross hairs may be adjusted by leveling the whole transit and finally the telescope. A pole should then be marked off to the exact height of the center of the tube and then the operator may sight on the pole at a distance of several hundred feet. The ground should be perfectly level in doing this and if it is not possible to get so long a range of level ground a shorter distance may be taken. After these corrections the instrument is ready for use. Its operation is essentially the same as any surveyor's transit of approved design.

Torque Rod Bracket Repair

The bracket carrying the front portion of the torque rod on the writer's



automobile broke one day at the point illustrated in the accompanying sketch. The car being an extremely old model, and knowing the delay occasioned by the ordering of a new part, it was decided to repair the break in the home workshop. The old bracket was first removed from the car and thrown in the junk pile. A piece of 3/8-inch flat steel stock was first annealed and then cut and hammered into the shape of a U of the proper dimensions. The necessary holes were then drilled and the new bracket was riveted to its proper place on the cross member. The entire job took but a few hours and the expense amounted to practically nothing.

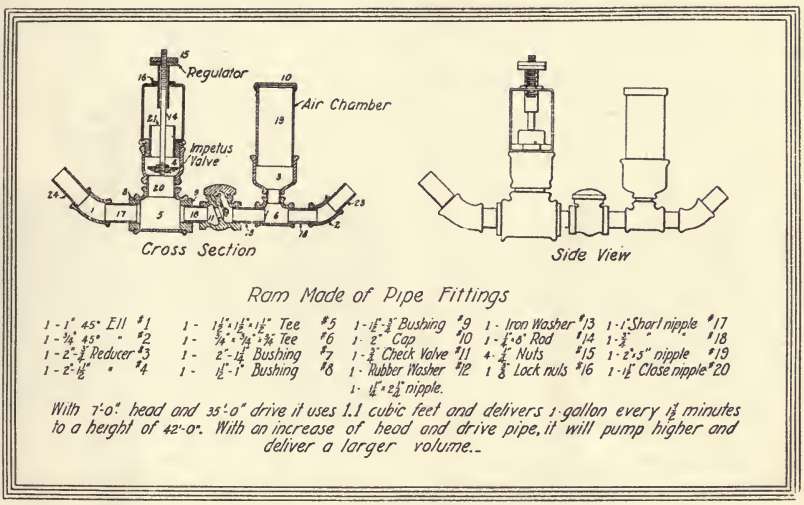
Contributed by

ADOLPH KLEIN.

Hydraulic Ram from Pipe Fittings

The contributor takes exception to the explanation of the process of purification offered in an article in the November issue of POPULAR ELECTRICITY AND MODERN MECHANICS under the title "A Sanitary System on the Farm." The article in question states that the absence of oxygen makes the bacteria destroy themselves and while it is true that the process of purification is due to bacterial action, the bacteria are those that can exist without the presence of oxygen. There are two classes, *i. e.*, "anærobic" or those requiring no oxygen, and "faculative" or those that can live with or without the presence of oxygen. In a sewage tank these two classes of bacteria use the organic matter as food which has settled out of the sewage thereby partially destroying it. A portion of it that is not destroyed is liquefied. For further purification the discharge from the tank could be run over a small space of ground filled with ¼ to 1 inch of gravel and drained at the bottom.

In order that the gravity water supply from a spring to the house might produce an effective 20 pounds pressure per square inch, the spring would have to be 40 feet above the fixture where the water is drawn and as springs are seldom found on a high piece of land with the house built in a hollow, this means of supplying water would not be practicable in many places. The drawing illustrates a simple form of hydraulic ram that may be made from pipe fittings and which will pump water to a height of more than 50 feet when placed 5 or more feet below the level of a spring and supplied through a pipe from 35 to 40 feet long. The entire bill of materials entering into the construction of this ram can be obtained at a plumbing shop for something less than $5. It is felt that a detailed description of the ram is unnecessary inasmuch as the construction is shown very clearly in the appended drawing.



Ram Made of Pipe Fittings

1 - 1" 45° Ell	#1	1 - 1½"×1½"×1½" Tee	#5	1 - 1½"-¾" Bushing	#9	1 - Iron Washer	#13	1 - 1" Short nipple	#17
1 - ¾" 45° "	#2	1 - ¾"×¾"×¾" Tee	#6	1 - 2" Cap	#10	1 - ¾"×6" Rod	#14	1 - ¾" "	#18
1 - 2"-1½" Reducer	#3	1 - 2"-1½" Bushing	#7	1 - ¾" Check Valve	#11	4 - ¾" Nuts	#15	1 - 2"×5" nipple	#19
1 - 2"-½" "	#4	1 - ½"-1" Bushing	#8	1 - Rubber Washer	#12	1 - ⅜" Lock nuts	#16	1 - 1½" Close nipple	#20
				1 - 1¼"×2½" nipple.					

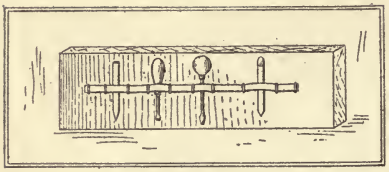
With 7'-0" head and 35'-0" drive it uses 1.1 cubic feet and delivers 1 gallon every 1½ minutes to a height of 42'-0". With an increase of head and drive pipe, it will pump higher and deliver a larger volume.

Contributed by

LESTER J. MILLER.

Handy Tool Rack

A tool rack is an absolute necessity to the handy man or model engineer. The rack shown in the illustration is made by stapling at intervals a length of rubber



of square section to a wooden back. It is most useful for odd tools other than sharp cutting tools.

Contributed by

J. N. Hill.

Storage Battery Containers

A cheap and highly satisfactory container for the elements of a storage battery or rectifier may be made of wood as follows: Make a box of the required size from white wood of suitable thickness, smearing the edges of the wood generously with an acid-proof cement. Also paint the inside of the box with the cement before assembling. (An excellent cement for this purpose was described by Earle E. Taylor in the July number of this magazine.) Reinforce the box wherever necessary with battens and permit a stream of the acid proof compound to flow down the inside of each corner and around the bottom of the box. Dip the top of the box in melted paraffin to keep salts from crawling.

Contributed by

George M. Hearne.

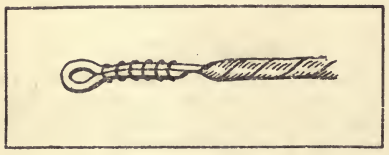
A Handy Lug

A handy lug or battery connector may be made from a cotter pin having a hole in the head sufficiently large to fit snugly over a battery binding post.

To make the connector, wind a piece of No. 20 copper wire around the legs of the cotter pin and secure by a drop of solder. Protect with tape and you have a lug that may be used to great advantage in many ways.

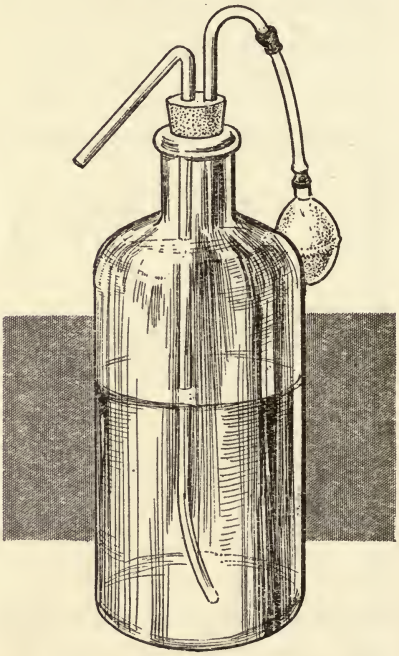
Contributed by

Lacy Conway.



Handy Siphon Bottle

A prescription department in a large city drug store has a handy utensil in the shape of a gallon siphon bottle for distilled water made with two pieces of glass tubing, a rubber tube,

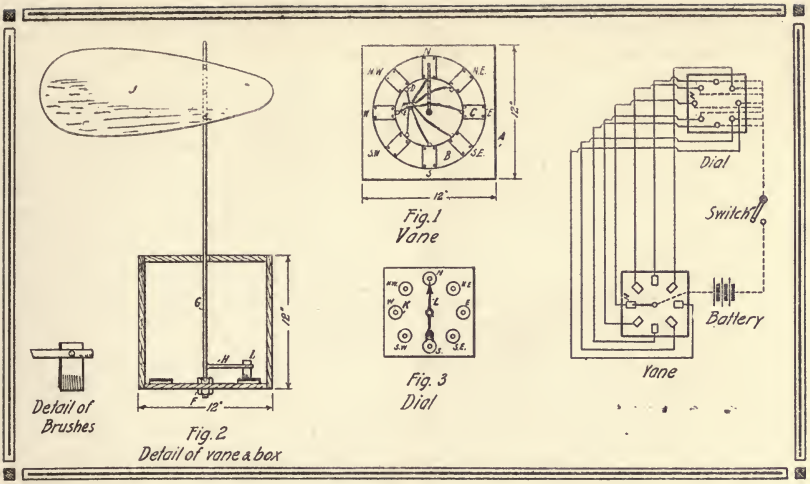


and an atomizer bulb. When the bulb is pressed air is forced into the bottle causing the water to flow into the prescription bottle held under outlet tube.

Contributed by

N. Mitchell.

¶ A good tinting fluid for incandescent electric lamp bulbs can be made by mixing aniline dye with a solution of water-glass. An inferior substitute for the water-glass is a solution of gelatine in water.



AN ELECTRIC WEATHER VANE

L. B. Robbins

Being a lazy individual and desiring to save myself the trouble of going to the window to ascertain the direction of the wind by the weather cock on the barn, I built a device that shows, by closing a switch in the house, which way the wind is blowing.

As will be seen by the following description, the device is quite simple and can be made by anyone at all handy with tools. It comprises essentially a vane and a dial.

The vane consists of the vane proper and the vane box. The bottom of the box, *A*, is made of a piece of one inch ash or oak 12 inches square. Find the center and describe two circles, 6 inches and 10 inches in diameter, respectively. Cut a ring from sheet rubber, such as is used by plumbers for packing valves, with the two diameters the same as the two circles on the board. Tack this ring to the board exactly over the circles so that it lies perfectly smooth and flat. This forms an insulated track, *B*, for the eight contact plates, *C*, which are cut from No. 18 sheet copper and fastened at each corner by ¾ inch brass screws. These plates are placed equidistant around the rubber track and represent the eight principal points of the compass. On the inside edge of the plates fasten a binding post, *D*. In the center of the base bore a ¼ inch hole and fasten a 1½ inch bolt, *F*, in the head of which has been drilled a hole ¼ inch in diameter and about the same depth. Somewhere between the center of the board and inner edge of plates bore a hole, *E*, through which the lead wires may pass.

Now, if you are enough of a blacksmith, take a piece of ¼ inch round bar iron, *G*, 2 feet 4 inches long. At 1½ inches from one end weld at right angles a piece, *H*, of the same stock 5 inches long. Saw a slot 2 inches long in the end of this arm and in one tine of the fork thus formed drill a hole and tap for a machine screw. This is to hold the contact brush, *I*, which is made of three or four strips of thin brass an inch wide and two inches long. Fringe these at one end for a space of

about ¾ inch. When laid together the plain ends are placed in the slot and held by the adjusting screw. Through the other end of the rod drill three ⅛-inch holes at right angles to the direction of the arm, the top hole two inches from the top of rod and the others two inches apart. Cut out the top of vane box and through the center bore a hole just large enough to take the rod without binding. Slip the top over the rod and box in three sides, making the box 12 inches square. Set the rod in the socket and adjust the brushes so that they bear lightly but firmly on the plates. The open face of the box should be closed by a hinged door through which adjustments can be made. The box when finished should be given two or three coats of linseed oil to protect it from the weather and prevent warping.

Now make a vane, *J*, and rivet to the rod through the three holes previously bored. The vane is best made of two sheets of light galvanized iron riveted together with an opening left to slip over the rod.

The dial is a series of eight magnets, *K*, arranged to correspond to the plates in the vane box. On a piece of wood 8 inches square describe a circle 6 inches in diameter and at eight equidistant points on the circumference drive a tenpenny nail, leaving the heads 1½ inches above the surface. Each nail when wound with a half a dozen layers of No. 20 insulated wire makes an excellent magnet. Cut an arrow, *L*, from some light non-conductor such as whale bone and at the point attach a small piece of iron. Find the balancing point and make a small depression on the under side. Mount the arrow on a pivot in the center of the dial so that it will swing at a height equal to that of the magnets and very close to them.

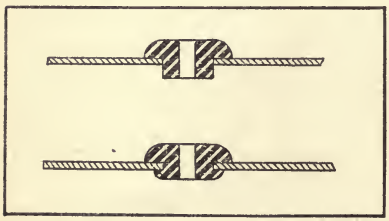
Place the dial in a convenient location in the house near the battery and switch, and secure the vane on the roof, with plate marked "North" pointing due north.

The wiring from the vane to the dial is shown in the accompanying diagram. The dotted line is the ground wire, leading from the bolt, *F*, to battery and switch, and ending with a branch wire leading to one terminal of each magnet. The solid lines represent the wires from each plate which lead to the second terminal of the corresponding magnet. Thus the wire from the plate marked "North" leads to the magnet marked North on the dial. Four cells of dry battery will be found sufficient for ordinary distances.

When the switch is closed it may be necessary to spin the pointer lightly so it can quickly seek out the right magnet through which the current is passing and thus indicate the direction of the wind.

To Fasten Socket Bushing in Fixture Canopy

Trim about one-eighth inch from the threaded end of a bushing and insert



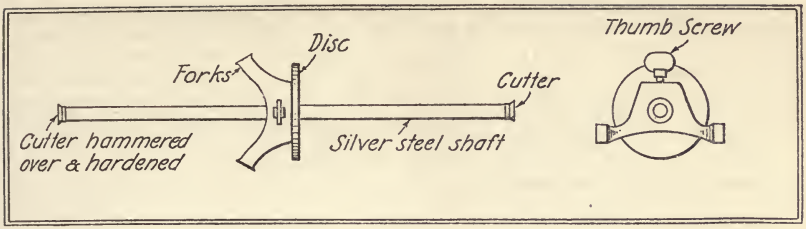
into hole in the canopy. Heat the threaded end with a match or candle, which will quickly soften the rubber. Before it hardens press out edges with the thumb, thus forming a shoulder and locking the bushing.

Contributed by

C. K. Theobald.

A Useful Marking Gauge

The illustrations show a simple marking gauge which the writer designed and made some time ago and which is now in constant demand among his fellow pattern makers. It will be seen that the gauge head has two working faces, the disc for straight gauging and the forks for gauging curved surfaces, two cut-



ters being also provided on the shaft. A pattern is required for the head—a useful lesson in small pattern making—and if the cutters are properly hardened the gauge may be used for marking metal as well as wood.

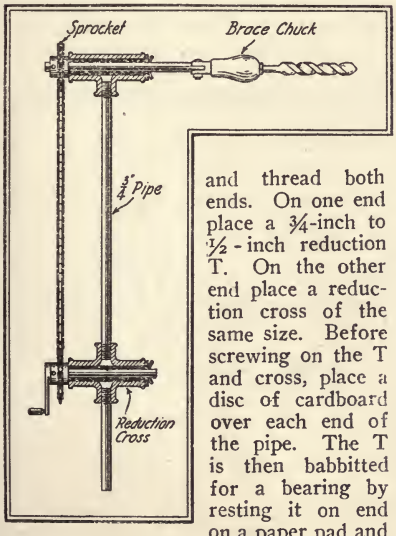
Contributed by

J. Nelson Hill.

A Boring Tool for Tight Places

A very satisfactory boring tool may be made out of pipe fittings as follows:

Cut a five-foot length of ¾-inch pipe and thread both ends. On one end place a ¾-inch to ½-inch reduction T. On the other end place a reduction cross of the same size. Before screwing on the T and cross, place a disc of cardboard over each end of the pipe. The T is then babbitted for a bearing by resting it on end on a paper pad and standing a ½-inch diameter steel shaft upright in it. The babbitt cannot escape as it is poured in around the shaft because of the disc closing the end of the pipe. A two-foot length of pipe is inserted in the other side of the cross and the cross is then babbitted to make a bearing similar to that in the T. Two sprockets are next procured and bored to fit the ½-inch shaft. One of these sprockets is fitted to the end of a 3½-inch length of shafting and this is put through the bearing in the cross, being held in position with a washer and cotter pin on the other end. A crank bolted to the sprocket completes the driving mechanism.



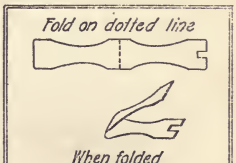
A shaft four inches long is fitted with the remaining sprocket on one end and on the other end is fastened a chuck removed from an old brace. It may be necessary to cut a shoulder on the shaft to make it fit into the chuck. A length of sprocket chain connects the sprockets and the machine is then ready for use.

Contributed by

Patterson D. Merrill.

A Handy Tack Holder

When one has to drive a very small nail or short tack it is often difficult to hold until it has "taken root" from the first blow of the hammer. The simple device shown in the accompanying illustration will prove very useful in such a case and it may be quickly made from



a bit of tin or cardboard. The nail or tack is inserted in the slot and the overlapping piece of metal serves to hold it by its head. This gives a sort of handle by means of which the tack can be held just where it is wanted and in a perfectly upright position, ready to be started with the first blow of the hammer. The holder can then be withdrawn and the tack driven home.

Contributed by

THEODORE GATHMANN.

A Convenient Wire Rack

A convenient wire rack with removable spools for holding lamp cord, fixture wire and various sizes of other wires from which small quantities are often taken, may be easily constructed as illustrated and described herewith.

The frame and spools are made of wood, the cores of the spools being about 3 inches square with rounded corners. For the spindles on the spools ¼-inch crowfeet are used. These nipples are threaded on both ends so that a crank, made from ¼-inch pipe fittings as shown, may be readily fitted to any spool for the purpose of winding. Slots are cut in the sides of the frame as shown, thus making the spools interchangeable.

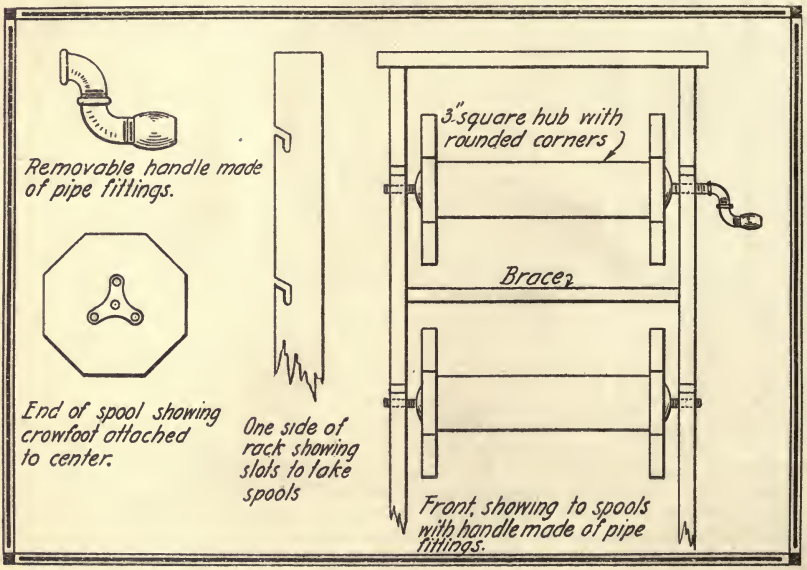
Cross braces are secured between the sides of the frame, and the rack is suitably fastened to the floor, about one foot from the wall.

Contributed by

C. K. THEOBALD.

Needle In Arm Located by Means of Magnetism

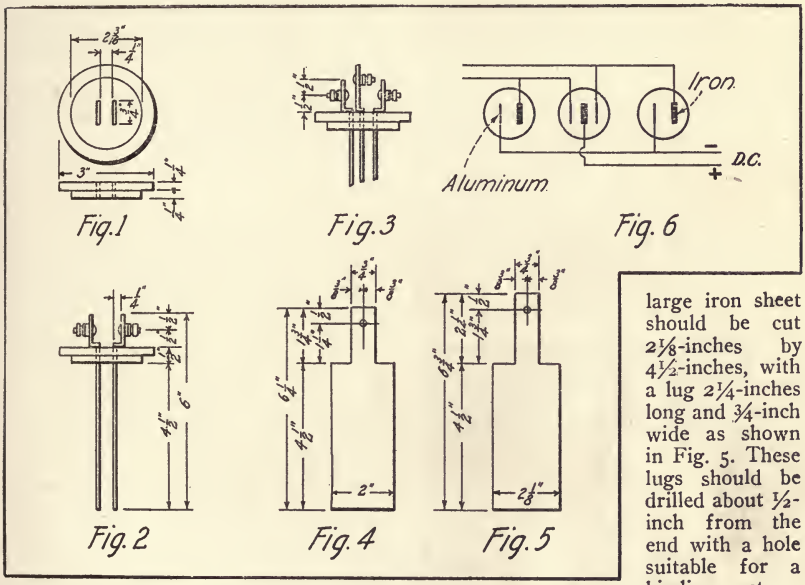
One of the employees at the power plant of which the writer has charge had the misfortune to break a needle off in his arm about an inch above the wrist. The local surgeon worked for some time and, as the wound was in a serious place, declared the patient should be sent to a city in order that an X-ray examination might be made. Through an ingenious application of magnetism, however, this was rendered unnecessary and it is believed that the method of procedure which resulted in the recovery of the needle, will be of interest to readers of this magazine.



ELECTROLYTIC RECTIFIER CONSTRUCTION

By Chas. E. Mullin

This rectifier utilizes both sides of the wave and may be connected directly to 110-120 volt A. C. without other resistance, thereby greatly increasing the efficiency. It will furnish 80 to 90 volts D. C. and will carry as high as 5 amperes on intermittent service. By doubling the surface area of the plates, the capacity may be considerably increased.



The following material will be required:

2 sheets of iron 2 × 6¼ inches, ⅛-inch thick.*
1 sheet of iron 2⅛ × 6¾ inches, ⅛-inch thick.*
4 sheets of aluminum 2 × 6¼ inches, ⅛-inch thick.
7 Binding posts.
3 one-pint Mason fruit jars.
1 piece pine or other soft wood, about ¼ inch thick, 4 × 20 inches.

The four aluminum and two iron sheets should be cut into plates 2 inches wide by 4½-inches long, with a lug 1¾-inches long and ¾-inch wide on one end of each, as shown in Fig. 4. The single large iron sheet should be cut 2⅛-inches by 4½-inches, with a lug 2¼-inches long and ¾-inch wide as shown in Fig. 5. These lugs should be drilled about ½-inch from the end with a hole suitable for a binding post.

Three discs, about 2 3/16-inches in diameter, to fit neatly into a pint jar, and three 3-inches in diameter, should be cut from the wood. These discs may be boiled in paraffine to prevent warping. One of the smaller discs is fastened in the center of each of the larger discs, as shown in Fig. 1, so as to form covers for the jars. In two of these covers, two slots, each 3/16-inch from the center and parallel to each other, should be cut as illustrated in Fig. 1, each ¾-inch long. One slot should be wide enough to tightly admit an iron plate lug, while the other should be wide enough to admit the lug of an aluminum plate. The third cover should have three slots, one in the center to fit the lug on the largest iron plate, and a slot 5/16-inch on each side of it, to take a lug from an aluminum plate, as in Fig.

* NOTE: Lead or carbon plates of the same surface area may be substituted for the iron plates.

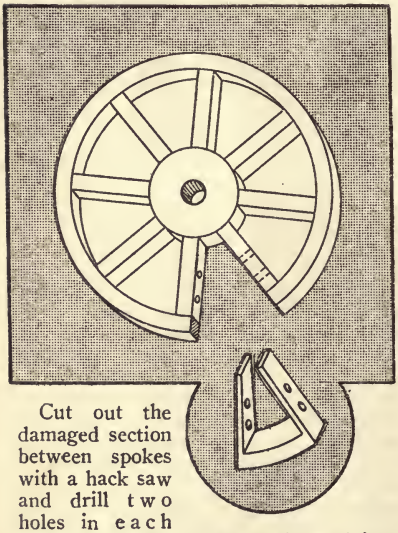
3. These lugs are forced through their proper slots in the covers, and bent L-shaped as shown in Figs. 2 and 3, so as to hold the plates in position, parallel to each other and ¼-inch apart. They are then fitted with suitable binding posts—the screws of which pass through the holes in the lugs—for connections.

The jars are filled to within ½-inch from the top, with a saturated solution of acid sodium carbonate, ($HNaCO_3$), in water. (The commercial $HNaCO_3$, commonly known as baking soda, which can be purchased from any grocer for about 10 cents per pound, is very satisfactory.) The covers are then placed on the jars; the plates extending down into the electrolyte. The plates are now connected as shown in Fig. 6, and the A. C. side connected to the line through a switch. The switch should be open when the rectifier is not in use. To start the rectifier, the D. C. circuit should be completed for a few minutes through a resistance. For convenience in handling, the jars may be mounted in a triangular or long box.

The tops of the jars should be dipped in melted paraffin to prevent the salts from creeping upwards.

Repairing Truck and Small Car Wheels

If the rim of a small car or truck wheel is chipped or broken it may be easily repaired by the following method:



Cut out the damaged section between spokes with a hack saw and drill two holes in each spoke for bolts. Have a piece of iron shaped at any blacksmith shop to snugly fit in the opening, drill holes to correspond with those in the spokes, adjust the section and tighten nuts.

Contributed by

B. W. Verne.

A Non-Acid Soldering Paste

An excellent non-acid soldering paste can be made by adding enough paraffine to a five-cent bottle of vaseline to make the mixture remain solid in warm weather. Add one-half ounce of zinc chloride dissolved in a little alcohol to the foregoing mixture and stir it thoroughly. The alcohol soon evaporates and leaves the chloride thoroughly mixed, when it is ready for use.

It will be found that only a small amount of this paste is required for a job and that the solder sticks immediately. Furthermore, the work—if it happens to be copper or brass—will not turn green. This paste is excellent for instrument work.

Contributed by

Warren C. Thomas.

Chemical Fire Extinguishers

It is important for builders of the fire extinguisher that was recently described in these columns to remember that sulphuric acid has the property of absorbing water from all convenient sources. It is therefore suggested that the acid bottle should be fitted with a loosely-fitting cork in order to prevent the acid from absorbing water and weakening itself, as well as running over into the soda solution. The cork should be made of lead.

Contributed by

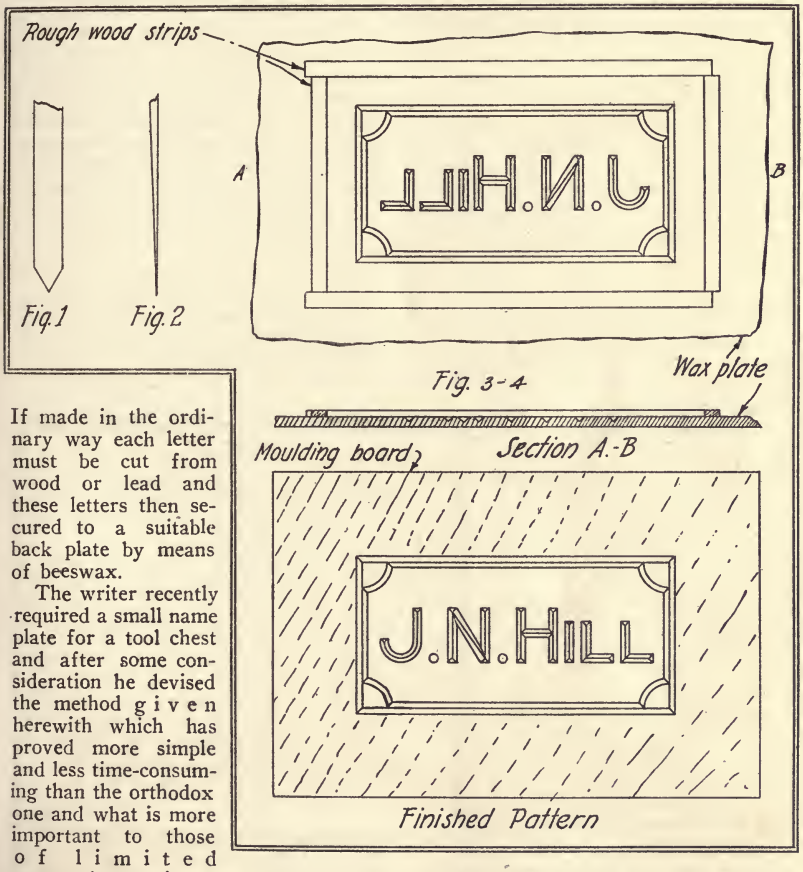
Warren C. Thomas.

MAKING PATTERNS FOR SMALL NAME PLATES

By J. Nelson Hill

Perhaps one of the most difficult jobs for an amateur patternmaker is a small name plate pattern with raised letters. If made in the ordinary way each letter must be cut from wood or lead and these letters then secured to a suitable back plate by means of beeswax.

The writer recently required a small name plate for a tool chest and after some consideration he devised the method given herewith which has proved more simple and less time-consuming than the orthodox one and what is more important to those of limited means it requires no special tools. A little thought will show the reader that if letters were cut backwards and deeply into a flat surface of wax and a plaster cast of this then made, the lettering will be raised and in the right direction. Care is of course needed and a few remarks as to details together with the illustrations appended will clearly explain the process. To make sure that the printing shall be uniform, the name plate is drawn full size on paper. This drawing is then traced through in order to reverse the lettering while held against a window pane. The ideal wax to use is that employed in casting talking machine records, but



this material is not always available and a good substitute will be found in beeswax. A thin plate of wax with a perfectly plane surface is prepared and the drawing of the name plate traced upon the surface. The lettering is cut into the wax with a special V-shaped tool made as shown in Figs. 1 and 2. The tool is held vertically when working and the user will find that it is quite a simple matter to carve out the reversed lettering cleanly and neatly.

Having finished the mold and decided upon the thickness of the required name plate, the worker should tack some strips of thin wood or cardboard around the recessed border but well away from it as illustrated in Figs. 3 and 4. The strips are oiled to prevent the plaster sticking, but oil must not be rubbed on the wax as it will tend to dissolve the latter. The pattern is cast from superfine plaster of paris which is mixed with water to the consistency of very thick paint. This mixture is then poured into the mould and the cast left to dry. This will take several hours and the worker must be very careful to leave the cast in position until the plaster is set quite hard, otherwise it will surely break when an attempt is made to remove it from the mould. If it does break, however, there is no cause for alarm as the pieces of the pattern may be stuck on a moulding board with thick shellac and then neatly varnished all over ready for the founder.

An Inexpensive Smoking Cabinet

This cabinet is made to hang in a corner of a room as the drawings indicate. The door is pivoted at the middle to swing quite around in either direction bringing the pipes, case and pouch holder to view so that they may be easily taken out when wanted. The pipe rack itself is a length of thick rubber stapled at intervals to separate the pipes. The pouch holder is a piece of wood screwed to the door on the angle. Brackets are put inside the cabinet both to strengthen it and to provide shelves for odds and ends.

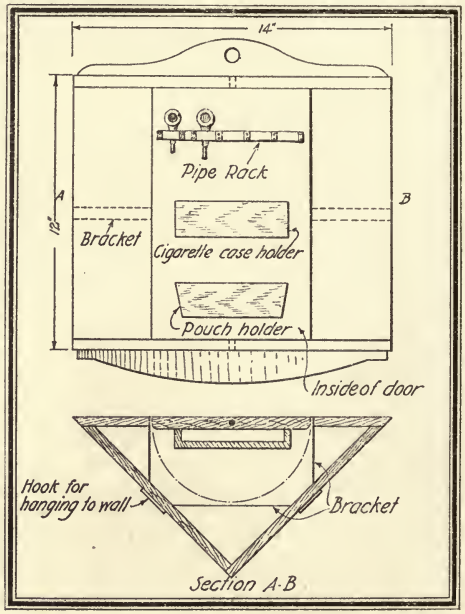
No special woodwork joints were employed in the construction, the complete cabinet being built up of white wood in a minimum of time. The severity of the plain panels and the door may be relieved by incorporating a fretwork design in some contrasting wood. The top shelf of the cabinet is used for the tobacco jar.

When the cabinet is suitably finished and rigged up in position, the maker will be able to sit within easy reach of his smoking tackle.

The cabinet may be stained to harmonize with the woodwork in the room.

Contributed by

J. N. Hill.



SOLDERING OUTFIT THAT IS ALWAYS READY

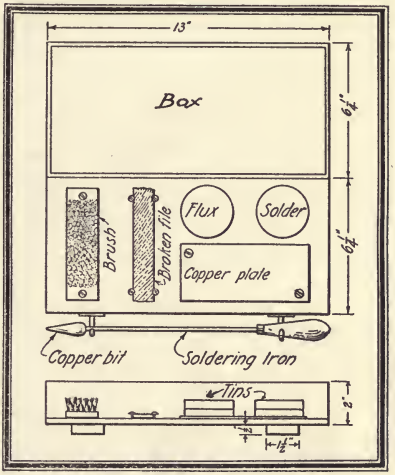
By Nelson Hill

Many readers may wonder why the above title has been chosen. The reason is not far to seek, for it is undoubtedly true that many of the failures which are met with when soldering are due to the fact that the necessary tools and materials are often scattered about, thereby confusing the worker when a cool head is essential. Considering that a knowledge of soldering is one of the chief assets of the model maker or handy man about the home, it is certainly worth the trouble of getting together an outfit that will insure a successful start.

The outfit shown in the sketches is easily assembled with the aid of a few tools and a little knowledge of wood working. It contains everything for soldering with the iron, which is the method usually employed. As the sketches are figured and lettered, a full description need not be given and a short explanation will suffice. The box shown at the top of the plan drawing is for oddments, *i. e.*, a piece of clean rag, files for cleaning up the work, etc. The outfit board on which the tools are fastened is the onetime lid of the box and these two parts are arranged as shown by screwing battens on the underside.

The brush for touching up the iron when heated and the file for the same purpose are both screwed to the board thus giving freedom for the hands to look after the job being done. The file is only to be used when the iron has been overheated and requires re-tinning. The box of flux and the box of solder are also screwed to the board. The piece of sheet copper is purposely fastened to the board in order that the worker may try the heat of the iron, for if the iron is sufficiently hot to run the solder on this it will be hot enough to solder brass or tin.

The two coat hooks to lay the iron on are screwed into the battens at the front. This completes the description of the outfit proper, but before ending a few tips on the use of the soldering utensils may not be out of place. When heating the iron do not get it to a red heat or re-tinning will be necessary. A point just below a dull red heat is the ideal state and it is best obtained in an ordinary fire or gas flame. Do not buy a very small iron, for it will not retain the heat. When soldering in awkward places the solder should be cut up in small pieces with shears, or scissors if no one is looking, and after fluxing the place to be soldered, putting several bits of solder in position ready for running with the heated iron.



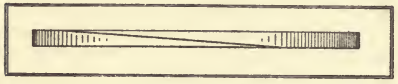
Cleanliness is the greatest point and the outfit described, in addition to having the merits before mentioned, will certainly aid in this. With such an outfit in his possession there is not the slightest excuse for the amateur if he fails to become proficient in the art of soldering.

Soldering Fluid

A good soldering fluid can be made by placing a few clippings of sheet zinc in muriatic acid; the zinc should be added in small quantities until the acid will not consume any more. When the boiling has ceased, the fluid is ready for use.

Leak-Proof Piston Ring

A common one-piece piston ring can be made very nearly leak proof by cut-



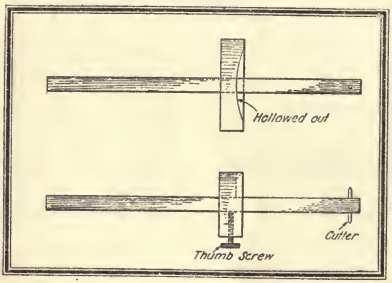
ting the joint as long and slim as possible as indicated in the sketch. The longer the cut, the narrower the crack after the cylinder wears a trifle.

Contributed by

W. F. SCHAPHORST.

Improved Marking Gauge

An ordinary woodworker's marking gauge can be improved to gauge lines around curved objects with the expendi-



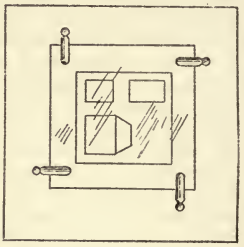
ture of a little time and trouble. The improvement consists simply in cutting a hollow out of the face of the head as shown in the drawing. The gauge may then be used for marking either straight or curved surfaces as desired by reversing the head on the rod.

Contributed by

J. NELSON HILL.

Printing Frame for Blueprints

A handy idea for use in an emergency when one has a large blue print to make from a negative or a tracing and when no regular printing frame is available is suggested in the illustration herewith. A plate of clean glass is backed up



with a piece of the thin wood used on the backs of picture frames and the two held together by means of four clothespins. The negative or tracing and the blueprint paper are placed face to face and held in close contact between the glass and the wood. When it is desired to examine the print in order to determine when correct exposure has been given, one clothespin may be removed and a corner of the wood lifted up without fear of getting the paper and tracing out of register.

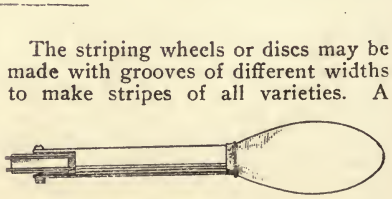
Contributed by

EDWARD F. HALLOCK.

PAINTER'S STRIPING WHEEL

This little device is used to paint a stripe on wagon bodies, autos, signs, machinery, etc. It is easily made and better and faster work can be done with it than with a brush. The device consists of a disc arranged to rotate in a slot cut in the end of a piece of brass tubing which has a rubber bulb attached to its other end. A quantity of paint is drawn through the tube into the bulb which is gently pressed to maintain a constant supply of color on the disc while the implement is in use.

The striping wheels or discs may be made with grooves of different widths to make stripes of all varieties. A



dotted line stripe may be obtained by cutting notches in the face of the wheel at regular intervals.

Contributed by

A. H. WAYCHOFF.

THE SPLIT LOG DRAG

By F. K. Haskell

The successful operation of a drag involves two principles: The first concerns the length and position of the hitch, while the second deals with the position of the driver on the drag. Each influences the other to a large extent and successful manipulation of the drag is dependent upon an understanding of both of them.

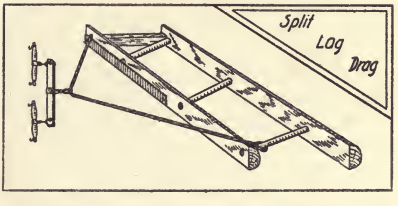
For ordinary purposes the snatch link, or clevis, should be fastened far enough toward the blade end of the chain to force the unloaded drag to follow the team at an angle of 45 degrees. This will cause the earth to move along the face of the drag smoothly and will give comparatively light draft to the team, provided the driver rides in the line of draft.

The distance from the drag at which the team is hitched affects the depth of the cutting. Shortening the chain tends to lift the front slab from the ground; a longer hitch causes the blade to cut more deeply. The length of the hitch may be regulated by lengthening and shortening the chain at the end which runs through the hole in the blade end of the drag. Usually two horses are enough to pull a drag over an ordinary earth road.

The object of the drag is to move earth toward the center of the roadway and to raise it gradually above the surrounding level. While this is being accomplished, all mudholes and ruts will be filled, into which traffic will press the fresh earth. The drag does the best work when the soil is moist, but not sticky.

In soils full of loose stones or even small boulders the drag does good service. The loose stones are drawn into a windrow down the center of the road, while the earth is deposited around the boulders in such a way that the surface is leveled.

The approximate cost of a split-log drag, labor and material is about $3; the



cost for dragging one mile, going over several times, team and driver, is just what you will make it from $1 up, depending on the number of times required to go over the rough road.

The advantages to be gained from the persistent use of a road drag may be summarized as follows:

The maintenance of a smooth, serviceable earth road free from ruts and mudholes. The obtaining of such a road surface with the expenditure of little money and labor in comparison with the money and labor required for other methods. The reduction of mud in wet weather and of dust in dry weather.

A WIRELESS DASHLIGHT

The small and familiar pocket searchlight has been utilized by a Massachusetts wireless enthusiast as a means of illuminating the dashboard instruments of his car. To the case of the searchlight he has fitted an attachment by which means it is held to the steering post, just below the steering wheel, thus making it very accessible to the driver. The lamp used has a locking device so that constant illumination may be had if the driver so desires.

This lamp is very useful and exceedingly inexpensive. It may be readily placed on any car that does not happen to be already fitted with an electric dashlight.

The Russian government has placed an embargo on all kinds of lumber, to prevent its exportation; walnut lumber, including Circassian walnut, much prized by American furniture makers, is specifically mentioned.

Where Shellac Originates

Dr. Leonard Keene Hirshberg,
A.B., M.A., M.D. (Johns Hopkins)

SEALING wax, furniture polish, varnish, lacquer, hot stiffening and "shellac" itself are all from shellac, one of civilization's first aids. Some fifteen thousand and more tons of shellac were imported into this country last year for use in the manufacture of talking-machine records, electric apparatus and many other things.

The shellac industry is one of the oldest known. It dates back beyond the oldest Sanskrit records and has been known for thousands of years. Yet this whole, great industry depends upon the life of an insect! Scientists in the employ of the British Indian Government have just published a monograph on this wonderful little creature and its behavior.

The scale-insect which makes shellac much as bees make honey, is a first cousin of those pests of every farmer, to wit, plant lice, the San Jose scale and other bugs, parasitic to vegetation. It is called the *Tacehordia lacca*, this shellac insect. It makes its abode upon all sorts of trees in India. The Banyan and Mango trees do not escape them. Each *Tacehardia lacca* is really a miniature siphon and great numbers of the insects dwell together in harmony. At the mouth of every one of them is a tiny lancet with which they pierce the tree. Through the opening thus made each insect leads a vegetarian life and sucks sustenance. Thus it draws sap from the tree which passes through its little body and after being modified is finally changed into the shellac which we know, which is excreted at the back. This "lac" accumulates and gradually builds itself up around the insect into a small, dome-shaped excrescence.

Owing to the legion of these insects, they have a tendency to melt and fuse together. Thus, a beautiful incrustation of shellac is formed upon the branches of the trees.

About the beginning of July, tiny red larvæ can be seen to swarm out of these incrustations in countless numbers. These spread hither and thither over the neighboring twigs. Each little larvæ is oblong in shape, with two minute eyes, two short feelers and six short legs.

Curious tufts of white, powdery hairs, which are actually the "lungs" of the insect, grow from its chest. For two or three weeks this "swarming" continues just as with bees. Each one sets about "setting up a claim," as it were, in order to start in business for itself to establish a "siphon" to make shellac on its own account. It must do this within twelve hours or its fate is sealed. During this time, it takes no nourishment. The greater number of them are, of course, doomed. Enough, however, are "lucky" and find an abiding place somewhere upon a twig.

At once the successful insect settles down to the business of eating and forming shellac. The female insects produce a larger incrustation than the males. At the end of two and a half months the male creeps out backwards from under the edge of its scales. It is now seen to have four eyes instead of two.

As soon as the males mate with females whom they soon find, they die, for their life work has been fulfilled. Two and a half months later the females stop work. They then lie quiet for another month and allow the thousand new-born young to leave their bodies. They, then, die also.

There are thus two generations every year. Were it not for their enemies, such as birds, cold, frost, caterpillars, siroccos, and the like, India would be overrun with these insects.

The shellac is collected to-day as it was, perhaps, ten thousand and more years ago. The natives simply break off the encrusted branches and sell them to jobbers as "stick-lac."

THE HOME CRAFTSMAN

Describing the Construction of a Simple Morris Chair, With an Explanation of the Mortise and Tenon Joint

By Ralph F. Windoes

Illustrations from drawings made by the author.

IN the greater number of furniture projects, the mortise and tenon joint is used almost exclusively. Its construction is rather difficult for the beginner, yet its holding power is great, giving it an advantage over other joints for this class of work. The simple design for a Morris chair that has been selected in order to explain this joint will, no doubt, appeal strongly to the home craftsman. In the retail furniture stores this chair sells for $21.00, while the home craftsman will be able to make his own for not over $15.00, depending, of course, upon the grade of leather that he purchases in the cushions.

The lumber needed should be purchased as follows, planed and sandpapered to exact dimension at the mill:

Legs, 4 pcs. 1¾"x1¾"x23⅜", plain oak.
Rails, 2 pcs. ⅞"x5"x21", quarter-sawed oak.
Rails, 2 pcs. ⅞"x5"x22½", quarter-sawed oak.
Arms, 2 pcs. ⅞"x4¼"x33½", quarter-sawed oak.
Back rod, 1 pc. 1 3/16"x1½"x21¾", plain oak.
Seat supports, 2 pcs. ⅞"x2"x19", plain oak.
Seat slats, 7 pcs. ½"x2"x22", plain oak.
Back verticals, 2 pcs. ⅞"x2½"x26", plain oak.
Back slats, 2 pcs. ⅞"x2½"x22", plain oak.
Back horizontals, 2 pcs. ⅞"x2¾"x16½", plain oak.

Begin the construction of the chair by cutting the tenons on the rails. Select the best piece ⅞" x 5" x 21" for the front rail. By *best* is meant the piece with the fewest imperfections as to grain and markings. Measure it very carefully and if it is over-dimension, cut it down to size. Consulting Fig. 1, it will be found that at *A* there is a piece represented in top, side and end view. Notice the "face marks"—checks on the "working face" and the "working edge." It is from these checked faces that the joints will be laid out, and in so doing remember this: *do not hold the head of the try-square or run the head of the marking gauge against a face that is not checked.* If one does, the chances for accuracy are greatly lessened. At *B* in the same illustration, one will find knife and gauge lines represented. Beginning on the left end of the board, measure in 1" and square around the piece, remembering the above rule. Actually *cut* in the wood to a depth of about 1/16" with the knife, as this will give the chisel a start when

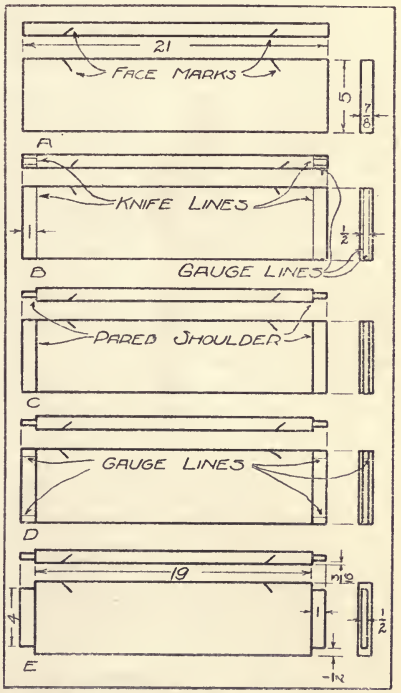


Fig. 1.—Methods of Cutting the Tenons on Chair Rails.

the shoulder is pared down. Next measure over from this knife line 19", and square another knife line around the piece. Be sure to measure over from the first line — not in from the other end, as exactly 19" is required between shoulders. Set the marking gauge — with the rule rather than by the scale on the gauge — for 3/16", and gauge over the ends and on the top and bottom edges to the knife lines—*running the head of the gauge against the checked working face.* Next move the gauge head over to 11/16" and gauge a parallel set of lines, as the drawing shows.

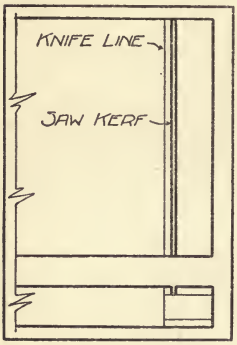


Fig. 2.—Method of Sawing Shoulder on Chair Rails.

In Fig. 2 is shown the method used in sawing this shoulder. Run the saw about 1/16" from the knife lines, cutting in the waste wood, down to the gauge lines. Watch the saw on both edges of the piece and saw straight across, using the back saw for this work. With a sharp chisel, cut out the waste wood down to the gauge lines, being careful to keep the cheeks of the tenon exactly parallel to the faces of the wood. You are now ready to chisel down the shoulders to the knife lines.

Consulting Fig. 3, an easy method is disclosed for doing this. Secure a small block of wood with two edges at right angles, and clamp it tightly on the piece at the knife line—one side of the right angle resting on the face of the board and the other running straight up from the knife line. Fasten this securely in the vise or to the bench top. With a 1" chisel, holding its back tightly against the block as the drawing illustrates, pare the shoulder down. This method will make a perfectly square, sharp shoulder —so essential to the proper fitting of a joint. But notice this, the back of the chisel must be perfectly straight. If it has any bevel at all, it will tend to run out at the bottom of the cut, preventing the joint from pulling up tight in its mortise. After chiseling on both ends in this manner, the piece should assume the appearance of *C*, in Fig. 1. At *D*, we find more gauge lines added; this time to the cheeks of the tenons and on their ends. These lines are gauged ½" from the edges of the wood, making the finished tenon 4" wide. Chisel on these lines, very carefully, and the result should appear as at *E*.

In this manner *all tenons* for the chair are cut, no matter what their size may be, or where they are located. It is the method by which the best work is accomplished, and the amateur craftsman should learn no other.

Returning to the large working drawing, notice that the back rail, on "The Main Frame of the Chair" will be exactly the same size as the one just described, and that the two side rails will have the same sized tenons, but the distance between their shoulders will be 20½" instead of 19".

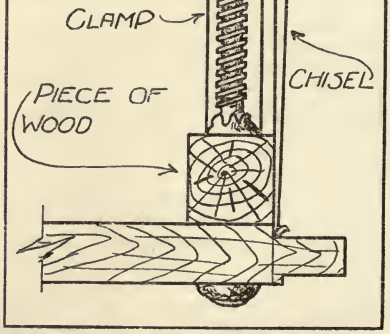
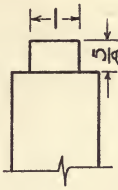


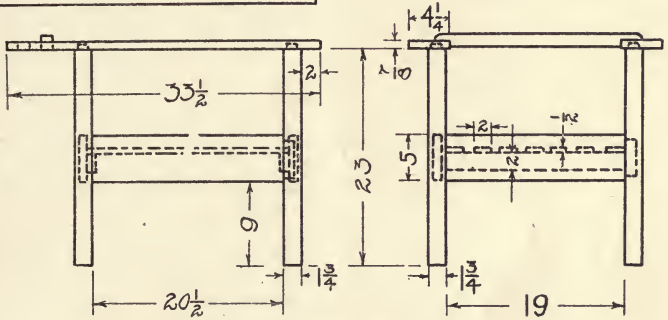
Fig 3.—Suggestion for Chiseling Sharp Corner on Shoulder.

When all of these tenons have been cut, lay out the short tenons on the up-

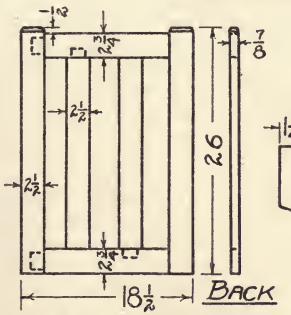
MORRIS CHAIR.



DETAIL OF UPPER END OF LEGS

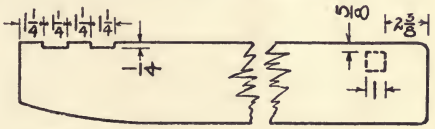


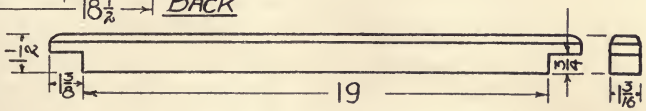
MAIN FRAME OF CHAIR



BACK

DETAIL OF ARMS





DETAIL OF BACK ROD

per ends of the legs. Notice the detail on the drawing. To do this, be very sure that you measure up 23" from the bottom ends of the legs, rather than 5/8" down from the top. Cut these tenons as you did the others.

Next turn to the "Back" in the working drawing. Notice that the horizontals are tenoned into the vertical sides, and the vertical slats into the horizontals. Be very sure that you understand the drawing, as small details have been omitted for the sake of clearness. For instance, the tenons, dotted lines, are only illustrated in the left vertical, but we know that the same construction holds true for the right, as both sides are alike. On the horizontal slats, only one tenon is illustrated on each slat, but, understanding as we do the construction of such a piece, this omission is not confusing. The same holds true in the main frame of the chair. Notice in the front elevation that the tenon on the front rail is illustrated on the right end only, the same space on the other end being used to show the end view of the side rail. On the side elevation, in the same drawing, the right tenon of the side rail has been drawn in, as well as the end of the front rail and the strip that holds the seat slats, the result being quite confusing. On the left end of same, the tenon has been omitted, resulting in a clearer understanding. Hence, in our furniture drawings, we will omit invisible edges where the construction will be made clearer by so doing, but, because one tenon only is shown, it does not mean that the other end of the same piece has none. If one tenon should be missing, we will make a note of it in the descriptive matter.

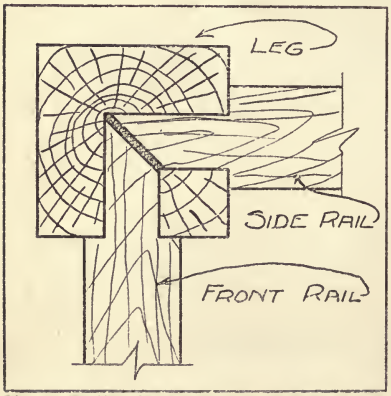


Fig. 4.—Mortises in Legs of Chair to Hold Tenons.

Next, turn to the mortises into which the tenons will fit. Consulting Fig. 4, which is a cross section through one of the legs at the point where the tenons enter the mortises, we find that the latter run straight through into each other, and the ends of the tenons are cut off at an angle so that the rails can be brought tight up against the legs.

In Fig. 5 is depicted the layout for the mortises. Notice that the working corner is the inside corner, and that a mortise is cut into each working face. The reason for doing this is apparent; since it is desired to have the rails at right angles to each other when they are assembled, we are more sure of it if we use these faces, as they *must* form a right angle to begin with. The two opposite faces seldom form one from their construction.

Lay the mortises out from the drawing, the bottom knife line being 9½" from the bottom of the legs, and the top one 4" up from that. The lines are gauged 5/8" and 1⅛" respectively from the working corner on both faces. Be sure that you do not run the gauge or the knife lines out from the corners where they cross over 3/16", as the shoulders of the rails will not cover them if you do.

With a 7/16" bit, bore a series of holes between the lines the depth of the mortises, and chisel the cheeks at right angles to the faces. Fit each tenon into its respective mortise as the work progresses, and mark both tenon and mortise with a corresponding number when they close up tight. After these leg mortises have all been cut, fit the frame of the chair together, and clamp it up, without using any glue, in order to see that it is square and firm. If you find it so, glue it together and clamp it tightly, being very sure that the corners are square

Next, notice the detail of the arms and work them to shape very accurately. The left arm, as you would face the chair from the front, is the one detailed, and the right is exactly like it but reversed. Do not cut the 1¼" slots for the back rod to fit into until the arms have been attached. Cut the mortises for the front leg tenons and fit the arms in their places before laying out the back mortises. These, being rather shallow, will need to be chiseled out entirely without boring any holes first, as you will then run no risk of the worm of the bit protruding in the face of the arm. When carefully fitted, glue and clamp the arms into place, pinning the tenons from the inside of the arms with ¼" dowels.

Next, cut the mortises for the chair back and glue these pieces up. The back can be fastened to the main frame with Morris chair hinges, which can be obtained in most hardware stores. They are attached to the top edge of the back rail and the bottom ends of the vertical members of the back, using flat head screws.

With the back rod made as detailed, place it into position against the back and mark the slots. Cut these with a sharp saw and chisel, so that the back will swing against the rod evenly and not touch it in one place only.

Screw the seat supports into place on the front and back rails, and nail the seat slats onto them. This completes the construction. Before finishing, see to it that every visible particle of glue has been scraped off and every rough or dirty spot removed. Then give the entire chair a good sandpapering with No. o sand-paper, and dust thoroughly. Stain, fill, shellac, and wax — processes that have been stated so often in this series that they need no repetition here.

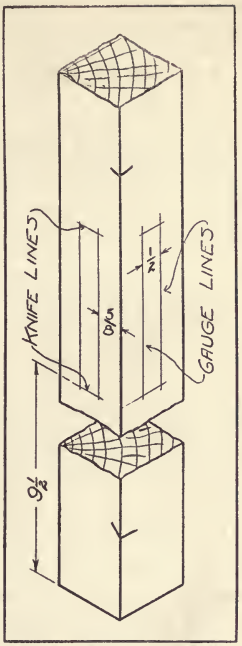


Fig. 5.—Layout for the Mortises.

Cushions, such as the ones illustrated, can be purchased in colors to match the finish of the wood.

It is said that a good flexible cement for rubber or leather can be made by mixing a small quantity of castor oil with thick shellac varnish. The oil prevents the cement from becoming brittle when dry.

IMITATING PRECIOUS STONES

Those engaged in the imitation of precious gems very often copy Nature with conspicuous success.

Zircons are composed of silica and zirconia. Their luster is deceptive, a means having been discovered of extracting the color, thus leaving them diamonds to all appearances, although their falseness promptly proclaims itself under test.

Precious stones are often dyed with such thoroughness that, it is claimed, the stone may be broken without discovery of the process, that is to say, by the uninitiated.

There is a town in Germany, Oberstein, the sole industry of which is the manufacture of imitation jewelry and the dyeing of chalcedony and other stones. The onyx, carnelian, bloodstone and agate may be enriched in color by immersion in the dye-pot. The stones are placed in vessels containing the coloring matter and are then subjected to great heat for periods varying from a few hours to a week or more. In the case of chalcedony, which shows bands

of different degrees of intensity, certain of the bands take the color and others do not. The stones then receive a further stewing in pots containing other dyes.

Fluorspar is capable of great improvement in tint when subjected to a heating process and crucidolite is given a hue of blood-red by a similar method.

The emerald and the cat's-eye are of all stones the most easily imitated. One family at Oberstein is said to possess the secret of converting crucidolite into cat's-eye. Cat's-eye may also be made of aragonite, some of the hornblendes, and even of fibrous gypsum.

CURIOUS PHOTOGRAPHY

Curious results are obtained when certain objects are photographed under different lights. For example, plates of a landscape obtained by infra-red light give the sky a jet black and trees and grass as white as snow. Ultra-violet light photographs or pictures obtained through a quartz lens heavily silvered on one side show white garden flowers as quite black.

If the moon's whiteness were due to the presence of zinc oxide, then the localities in which this substance was present when photographed by ultra-violet rays would not appear white, but black. This plan has been tried in the case of lunar photographs, and in the neighborhood of the crater Aristarchus it is clearly shown that there is a considerable area whereof the surface material differs from that in its proximity

In ordinary light this shows no variation from the rest of the surface, but repeated photographs taken with the quartz lens and silver lens prove that some unsuspected substance exists on that spot. The difficulty is to determine its nature. The only way at present, it seems, consists in photographing different rocks until one is found that presents the same characteristics as those of this district of the moon. There have been unavailingly tried lavas, volcanic débris, and minerals of many kinds.

THERMOMETERS TO MEASURE HEIGHT

The measurement of heat is by no means the sole function of the thermometer, since this instrument is also employed in the determination of the height of mountains.

The reason for this employment is to be sought in the pressure of the atmosphere on the surface of water. The greater that pressure the greater the temperature needed to boil the water. As we ascend there is less and less pressure, and water will boil at a lower temperature than 100 degrees Centigrade or 212 degrees Fahrenheit. For every one thousand feet of ascent water will boil at one degree Centigrade lower.

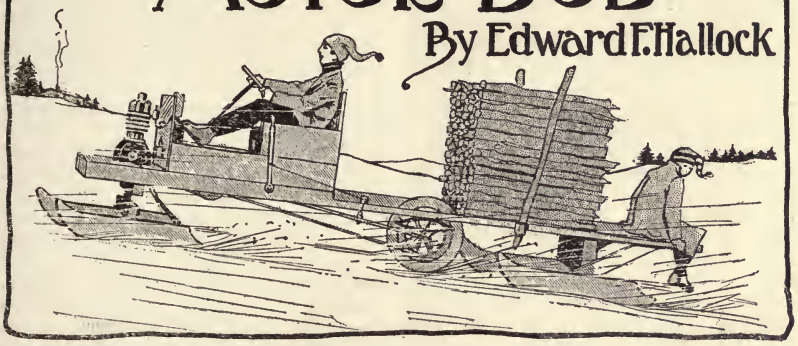
No ordinary thermometer, however, may be used in scientific work of this nature. Extremely delicate instruments must be employed. They must be quite lengthy, so that the scales may be divided into fractions of a degree. The apparatus for work of this sort is called a thermo-barometer or hypsometer. There is a small metallic vessel for boiling water, and on the inside of this vessel are placed these delicate thermometers. The claim is made that their accuracy is such that the height of a mountain may be determined within ten feet. It would seem, however, that this claim is not entirely justified, since the pressure of air does not decrease uniformly as the ascent is made. Despite this fact, the thermometer is a valuable aid to the surveyor.

MEETING OF COMMITTEE TO FORMULATE NATIONAL ELECTRICAL CODE

It is announced that the biennial meeting of the Electrical Committee of the National Fire Protection Association will be held during March, 1915, in New York City. The exact place of meeting will be announced later. As has been customary in the past, the provisions of the National Electrical Code as they now exist will be considered, together with the reports of all sub-committees, followed by such revisions and additions as may be found necessary.

Sleighing Up-hill In A Motor Bob

By Edward F. Hallock



If you have a motorcycle or a motorcycle engine at hand you will find enjoyable use for it during the Winter months by constructing a motor bobsled. But even if you have no engine and must purchase one, you will be amply repaid by the fun and usefulness derived from the motor sled. The construction of the motor bob may be altered, while such accessories as brakes, lamps, comfortable bodies, etc., may be added, at the desires of the builder. In an early issue of Modern Mechanics there will be described a cyclecar employing the same motor and transmission, so that the investment may be worked to the utmost during every season of the year.—The Editor.

NOT all of us, unfortunately, reside in those portions of the country where the flowers blossom the year round and where snow never falls. For such of us as do make our homes under these ideal conditions, the open season for motorcycles or cyclecars, as the case may be, extends from one end of the year to the other, barring a few wet days which only serve to make the dry ones more enjoyable.

For the great majority of those who make use of the light motor vehicles either of the two or four-wheeled type, the first touch of frost, heralding the coming of cold weather, hastens our efforts to find a suitable place and put our machines in "dead" storage for the winter. But as we take our bobsled from the barn or the cellar or other convenient place in order to make room for the motor vehicle that is to lay inactive during the winter months, one cannot help but feel that the enjoyment to be gotten from coasting down the long inclines and icy slopes on the steel-shod bob would be ever so much keener were it accompanied with the knowledge that the vehicle was also capable of transporting its load back up the hill again. And the thought of the power plant of the motor vehicle lying *passé*, so to speak, during the months to come leads a few of the more progressive and ingenious to attempt to devise a plan whereby the motor can be made to propel the sled with the same vim that it exerts when on the wheeled vehicle. And here's one solution of the problem, and withal a simple one that can be worked out by

anyone with few tools and little trouble.

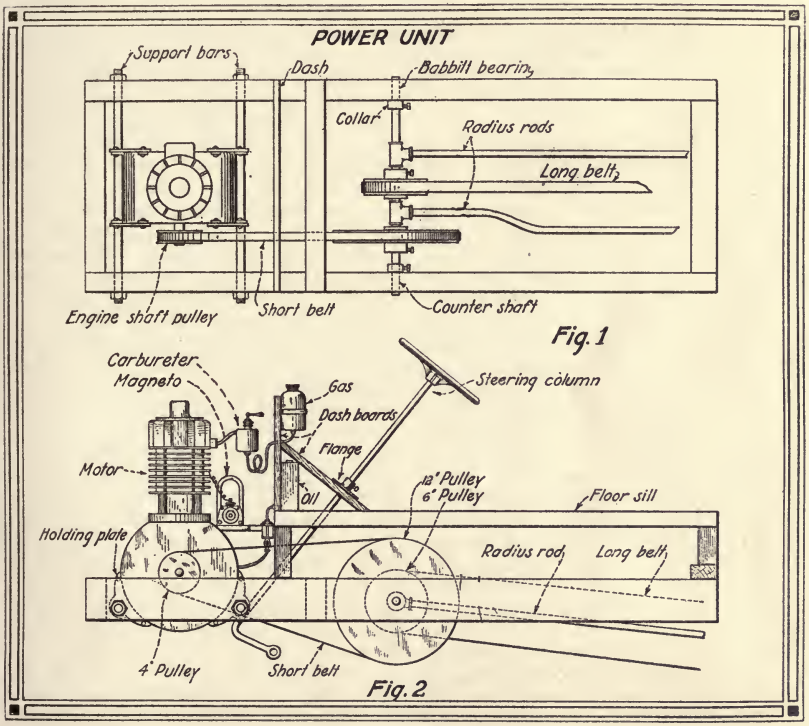
With the details of the construction of the sled itself, we will not greatly concern ourselves. Suffice it to state that, save for a framework of 2 by 4-inch timbers which offers a firm support not only for the flooring holding the passengers, but also for the power plant and transmission system, it is orthodox in every way. By way of adapting the power plant so that it can be removed from the sled and used in connection with a cyclecar during the summer months, it has been designed so that it is, with its countershaft, a unit that may be separated from the remainder of the vehicle simply by undoing a couple of lag screws which serve for the attachment of the motor-supporting frame to the framework of the bobsled.

The arrangement of the motor and the countershaft which serves as a gear ratio reducing element, is best made clear by reference to Fig. 1, which is a plan of the power unit with the accessory devices such as the tanks, steering column and floor boards removed to expose the more vital elements to view. The supporting frame is made of a couple of stringers of 2 by 4 spruce or pine five feet in length, spaced 20 inches overall apart by means of cross pieces of the same material. The four-inch faces of the string pieces are made the vertical sides so that the greatest strength is obtained. One of the cross members is placed across the front, directly between the two pieces, while another is distanced two feet on centers behind the front member. Six-inch cut nails are used to secure the joints. The rear cross member is not interposed between the two side members of the frame, but is laid across the top, as is clearly indicated in the diagrams, and nailed down in place so as to provide greater clearance for the main driving belt.

The motor, it will be seen, is held firmly in place in the space between the front two cross members, being attached by means of anchor plates to a pair of supporting bars. These bars are formed of suitable lengths of ¾ inch pipe made a tight fit in holes drilled through the two string pieces. They are locked firmly in place at either end and insured against movement by pins which are driven through suitable holes drilled through the pipes. These bars, it will be noted, also serve to make the motor framework more rigid. The distance between the bars, will, of course, depend upon the overall dimensions of the crankcase of the motor that is used. Before the dimensions can be determined with any degree of accuracy, it will be necessary to have the anchor plates, which serve to attach the motor to the bars, made by a blacksmith. These plates are made of ¼ inch boiler plate, suitably shaped so that holes can be punched to take at least two of the bolts that pass through the crankcase as well as a suitable hole for the passage of the supporting bar. When the anchor plates are ready, bolt them in place on the base chamber and measure the distance between centers of the bar holes on the respective plates on either side of the motor. This distance is the space that should be allowed for between the holes drilled for the supporting bars in either of the string pieces, and obviously, the holes in the respective frame members should be equally spaced from the front of the frame else the motor will not line up correctly in the frame.

Before finally setting the motor in the frame, the overall width of the motor between the outside faces of the face plates should be obtained and this measurement subtracted from the distance between the inside faces of the string pieces or side members of the frame, which obviously will be about 16 inches. The remainder after the subtraction should be divided by two and four lengths equal to this dimension of one inch or 1¼-inch pipe cut to slip over the bars between the anchor plates and the side frames so as to space the motor correctly in the center of the framework and ensure its staying there. These retaining collars should be put on when the motor is being placed in the frame the last time, and obviously if they are a little tight fit between the members that fact will prove rather beneficial than otherwise for it will result in a more firmly mounted motor.

The countershaft is placed directly behind the center cross member of the frame, sufficient clearance being allowed, of course, between the cross member and the larger pulley to defeat all chance of the pulley rubbing against the cross piece. As for the pulley dimensions they, of course, will depend upon size of the motor, or more truthfully upon the power which it is capable of delivering. In the sketches a single-cylinder motorcycle motor is indicated and the pulley diameters are based upon the assumption that the motor is capable of developing between four and five horsepower, which is the average performance of motors of this type. The belt pulley on the engine crankshaft is four inches in diameter and it drives to a pulley 12 inches in diameter; the ratio is obviously 3 to 1. However, the smaller pulley on the countershaft is but 6 inches in diameter while the belt rim on the motorcycle rear wheel which is used as a propelling wheel and to which it is belted scales at 20 inches. Therefore, the ratio of this secondary drive system is 3⅓ to 1 and the ratio of the complete drive system 3 times 3⅓ or 10 to 1. It will be found that with a motor of this size, the ratio indicated will give about the best all around results, permitting the heavily laden vehicle to be started without undue tendency for the motor to stall, and adapting it to climb some surprisingly steep hills or push its way through deep snow without overworking the little power plant. At the same time, when the character of the surface which is being negotiated permits, a speed of from



15 to 20 miles an hour can readily be attained and maintained.

With a twin-cylinder motor developing from seven to ten horsepower, it is readily apparent that the gear reduction need not be so great, for the greater power and more uniform torque of the double-cylinder power plant makes starting and hill climbing easier. In this case higher gearing will permit of greater speed being attained on the level without risk of speeding the motor past its critical point and thereby harming the mechanism. In this case the use of a ten-inch large pulley and an eight-inch small pulley on the countershaft is to be recommended as producing the best ratio for all around service.

The countershaft itself is a piece of cold rolled steel shafting ¾ inch in diameter. It is just a trifle over 20 inches in length so that when it is journaled in the side members of the frame, it protrudes just a bit over the sides. It is mounted on babbitt bearings which are cast into the side members. The method of forming the babbitt bearings is shown by one of the smaller illustrations. After the size of the larger pulley has been determined as outlined above, a distance which will give the pulley ample clearance with regard to the center cross member of the frame is determined behind this cross member as the location of the countershaft and holes 1½ inches in diameter are drilled at this point through the side members. Care should be taken in drilling these holes, not only to distance them correctly from the cross member and between the top and bottom of the frame members, but also to drill them perfectly true with regard to faces of the beams. It will be seen that the diameter is a full inch greater than the diameter of the shaft providing for a bearing ½ inch thick all around the shaft. Directly over the center of these holes and leading into them, vertical holes ½ inch in diameter are drilled, providing the channels through which the molten babbitt is poured in the making of the bearings and afterwards, when the bearing has been formed, the metal core which not only forestalls the bearing rotating in its socket or working out of place, but the medium through which the oil hole for the lubricant is drilled.

When the holes have been finished to the satisfaction of the operator, preparation is made for pouring the metal into them. Four cardboard dams are made, properly provided with holes through which the shaft slips snugly, and these are positioned on each side of the respective string pieces and tacked firmly in place with carpet tacks. Care should be exercised in positioning the cardboard retaining pieces, of course, to see that the holes for the reception of the shaft are exactly concentric with the holes in the string pieces so that the shaft is exactly true with relation to the framework. A layer of tissue paper then is pasted over the ends of the shaft where it passes through the string pieces in order to provide the necessary clearance for free running after the babbitt has been poured. The shaft is placed in position once again, and to eliminate all chance of the metal escaping through slight fissures around the shaft, the portions of the shaft adjacent the cardboard dams should be wound with asbestos cord. The babbitt, of good quality, should be heated to a point where it will just char a piece of wrapping paper which is dipped in it and held for a minute or two. If it is colder than this it will not run freely, while greater temperature results in brittleness in the cast. The dross should be caused to rise before the metal is poured by stirring in a bit of paraffine, after which the top is skimmed with an iron spoon. The metal should be poured through the vertical hole in the string pieces until the hole is entirely filled. When the metal has cooled down, the shaft can easily be driven out and removal of the cardboard and all traces of the tissue paper will reveal perfect journals. A drill then is passed down through the cores of metal clogging the pouring holes and serves to make perfect oil holes for the lubrication of the bearings.

A wick of twisted cord inserted in the oil hole will tend to hold the fluid and keep it from spilling and it will also serve to prevent dirt and grit from entering.

A couple of ordinary hexagonal nuts of proper bore for the reception of the shaft, and provided with steel set screws for attachment to it, serve to retain the shaft in proper position and are placed at either end just inside the string pieces and bearing against the babbitt journals. The pulleys are quite as simply made as the rest of the device. They are of 2¼-inch face made to take a 2-inch flat leather belt such as is ordinarily used for the transmission of power on belt drive motorcycles. They are built up of three pieces of ¾-inch plank sawn to correct diameter and screwed together cross grained to eliminate all chance of splitting or warping. The sawing, of course, is best accomplished with a jig saw, but an ordinary keyhole saw will serve the purpose, if carefully handled, in the absence of the more expensive tool. When assembled, the face of the wheel should be well sandpapered to eliminate all roughness and the face should be slightly rounded or crowned with a file or rasp in order to keep the belts centered. The wheels are provided with ½-inch pipe flanges with the holes reamed to ¾ inch to fit snugly over the shaft, and which, like the collars, have been provided with steel set screws to grip the shaft and hold the wheels in place. Of course, the wheels are drilled for the passage of the shaft.

Before proceeding to tell how to assemble the shaft

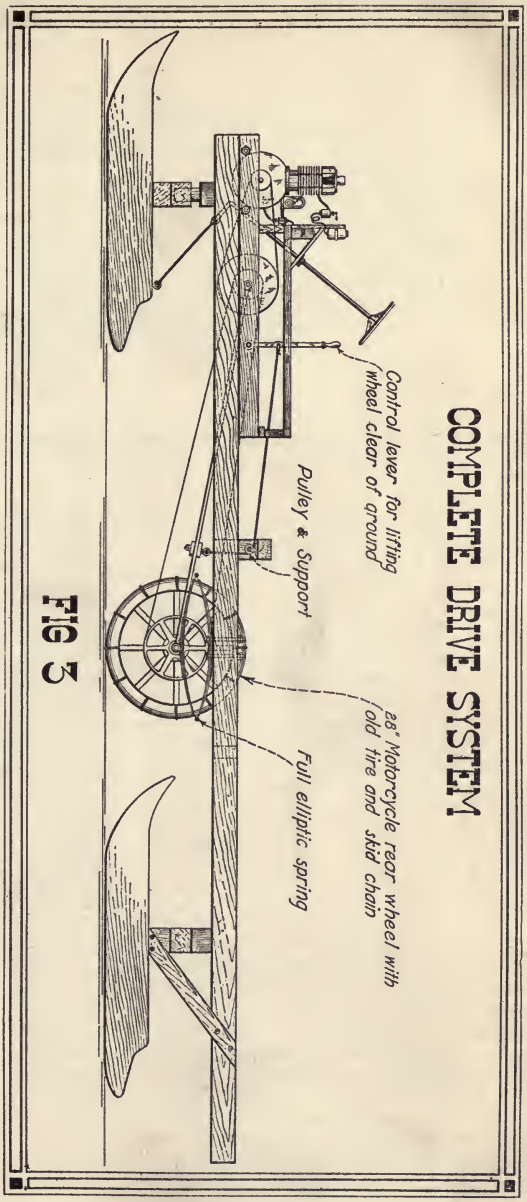


FIG 3

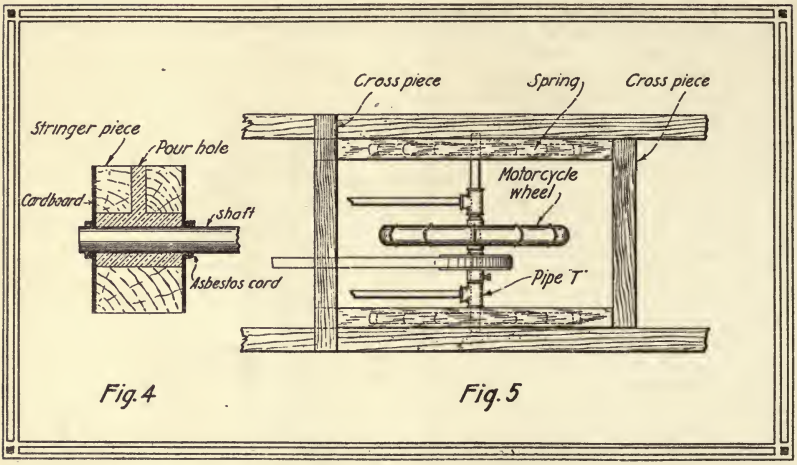


Fig. 4 Fig. 5

when bearings and pulleys have been completed, it is well to call attention to the method of control of the vehicle. By reference to the sketches it will be discovered that power from the countershaft is transmitted by means of a belt to a 28-inch motorcycle or cyclecar wheel mounted at a point near the middle of the bob. This wheel, ordinarily, is held in contact with the snow-covered surface of the ground by means of a couple of full elliptic leaf springs which have been procured from some discarded push cart or from some wagon builder. It is shod with an old tire, either inflated, if it be good enough for that, or else filled with sand or some other substance so that it retains its shape. It is caused to grip the slippery surface by means of a skid chain which is tightly adjusted to the tire. A pair of radius rods, made of ½-inch water or gas pipe, are interposed between the axle carrying the wheel and the countershaft and serve to preserve the distance between the wheels and keep the belt always at the proper tension. Under these conditions, it will be readily apparent that the drive wheel is free to move over rough ground and bob up and down without in the least interfering with the certainty of the drive.

Provision is made for lifting the drive wheel clear of the road surface by means of a lever pivoted to the subframe member close to the steering column and handy to the hand of the operator, which acts through a pulley and woven iron cable to lift the wheel from the ground through the intermediary of the radius rods, as is clearly shown. By this means the use of a clutch and some special means of starting the engine are eliminated and the mechanism considerably simplified. The clutch effect is not done away with, however, for by gradually bringing the drive wheel in contact with the icy surface, the vehicle is gently but firmly started on its way, provided, of course, that the motor is running. A latch, obviously, is provided on the control lever, which may be either foot or hand operated, to keep the wheel in inoperative position when need be. As for starting the motor, that is simplicity itself. The wheel, lifted clear of the ground for the purpose, is given a flip over in the right direction turning the engine over with it until it fires. Even a belt idler is done away with by this means.

The method of mounting the drive wheel is made clear by the accompanying sketch. A sort of sub-frame is made inside the larger frame, with two cross members and two longitudinal struts to

which the upper ends of the springs are firmly bolted. The forward cross piece is placed across the tops of the two string pieces to provide for belt clearance, but the rear one is between them and all joints are made fast by nailing with cut nails. The short axle of the wheel is discarded, and in its place is used one of sufficient length to provide bearing not only for the lock nuts but also for the Ts which are used on the ends of the radius rods and for the springs. The axle can be made up at any machine shop at very slight cost and should be made of the best steel and threaded from both ends for the greater part of its length to provide for the adjustment of the ball bearings. If the Ts on the ½-inch pipe should prove loose over the axle, which undoubtedly they will, the fault can be corrected by the use of babbitt metal to fill up the space and eliminate slack. T pieces are also used on the countershaft end of the radius rods and in this case the holes are filed or reamed out until the shaft turns freely through the holes. The device is assembled as shown in the sketches.

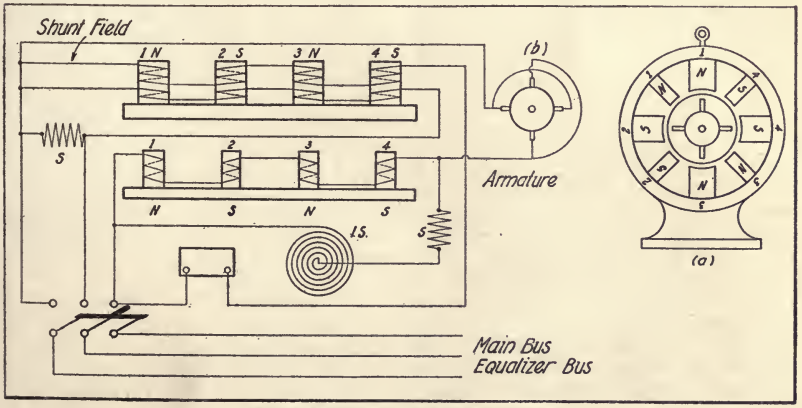
As for the rest of it, that is best left to the individual tastes or requirements of the builder. Of course, some sort of a steering column will be desired, and an arrangement of the sort is worked out in the plans. A flooring for covering the transmission elements also is shown, as well as a dash for the support of the gasoline and oil tanks, but as was said, these details are best left to the individual tastes of the builder and are not vital to the correct operation of the finished bobsled. A headlight and automobile horn will prove valuable.

INTERPOLE DIRECT-CURRENT MACHINES

By J. H. Wickman

IF a number of turns of insulated wire, connected in series, are rotated within the fields of magnets, an induced current is set up in the wire. If no means of commutation is provided, it will be an alternating current; but if a commutator—like those used on direct current machines—is provided to keep the direction of flow the same, it will be collected as direct current. Thus we have the main principle of generating either alternating or direct current.

When direct current is commutated,



Wiring Scheme for an Interpole Dynamo.

or, as we may say, reversed in the coil, since this is really what it does, a local magnetic flux due to the current also reverses and in so doing sets up an electromotive force in the coil which opposes this reversal and is referred to as a reactive voltage.

When the armature is revolving and carrying a heavy load, the lines of force have a tendency to bunch at the tips of the poles in the direction of rotation, thus causing an uneven distribution of magnetic flux over the pole face, which also means an uneven distribution over the armature face as well, forming one cause of poor commutation of currents and sparking at the brushes.

Until a few years ago this sparking could only be counteracted by shifting the brushes ahead in the direction of rotation of the armature to a neutral point which theoretically would require a movement of the brushes for each change of load on the machine. In recent designs of nearly all direct current machinery the auxiliary poles intermediate between the main poles, shown in part *a* of the diagram, have been introduced in order to obtain satisfactory commutation with a fixed brush position for all loads, this being the most satisfactory solution from the commercial standpoint.

These auxiliary poles are wound to carry a proportional part of the main current, being shunted by the series shunt *S* and the inductive shunt *IS*, shown in part *b* of the accompanying sketch. The inductive shunt acts as a reactance in case of a heavy overload and forces more current through the interpole windings, thus compensating for all loads automatically. These shunts are not used with some of the smaller machines, and in such cases all of the main current passes through the windings of the interpoles.

The windings are proportioned to provide a magneto-motive-force at any load sufficient to neutralize the armature magneto-motive-force and to provide a field of sufficient intensity to neutralize the reactive voltage set up in the armature coils while short-circuited under the brushes, or, in other words, the function of the interpole is to provide a magnetic flux of force opposite to and greater than the flux which produces the reactive voltage in the armature coils.

SPARKING OF INTERPOLE MACHINES

Sometimes conditions arise to counteract the effect of an interpole; this defect usually manifesting itself by a local sparking at one or more of the brush studs, while the commutation at the others will remain good. This effect can be caused by a short-circuit within the interpole winding, which may be detected by a resistance test of each of the interpoles until the affected one is located.

Frequently at the first installation a heavy local sparking will be produced by the reversal of one interpole, although in this case the effect on the operation at this one particular brush stud will be a worse sparking than if the coil were short-circuited, because by reversing an interpole it will increase the reactive voltage instead of decreasing it. The reversal of the entire interpole circuit will usually—but not always—manifest itself by heavy sparking at all the brushes on light loads. A polarity test—which is nothing more than to take a small hand compass and go around the pole pieces while they are magnetized quite strongly and see that they are in the right relation with reference to the rotation—may be applied in order to correct any reversed condition.

The diagram in part *a* shows the correct position of the poles with reference to the direction of rotation which is shown by the arrow. The remedy, after finding the wrongly connected pole or poles, is to reverse the connections in order to maintain the series of interpoles alternately N and S in the periphery.

When making the connections of the interpole circuit, care must be taken that the polarity of this field is correct with reference to that of the main shunt field, that is, the connections must be such as to place a N

pole of the commutating field ahead of the N pole of the main field, that is, beyond it in the direction of rotation.

With reference to the diagram, No. 1 N commutating pole lies ahead of No. 1 main pole with reference to the direction in which the arrow is pointing.

CARE, OPERATION, ETC.

The general care, control, operation and maintenance of this type of machine is about the same as any other direct current machinery, with the exception that when it is necessary to reverse the direction of rotation by means of the field connections, the extra field would have to be reversed as well as the others. These machines will carry a momentary overload of 400 or 500 per cent. without undue sparking at the brushholders, which is a large factor in their favor.

THE PREPARATION OF EMERY

Emery stone does not go upon the market in the same form in which it comes from the ground. It is mined in various places in the form of a loose or compact granulation. It is found in Greenland, Europe and Asia Minor. It has also been found in the United States at points bordering the Atlantic coast from Massachusetts to Georgia.

The deposit, after being mined, is crushed into small pieces. These in turn are pulverized by stamping. The powder is then put through one of two processes of grading according to fineness.

The first method is the simple one of merely sifting through sieves of graduated sizes of mesh, beginning with the coarsest and working down to the finest. The second method is somewhat more complex. A number of copper vessels, graded in size, are prepared, set in a row, and filled with water. The emery dust, churned up in water, is then piped into them, beginning with the smallest and proceeding by stages to the largest. The agitation of the emery-bearing water is greatest in the smallest vessel and consequently the largest grains of emery will first sink to the bottom of that vessel. The grains which are a degree smaller will be deposited in the next largest vessel, and the process may be carried as far as is desired.

After being thus precipitated the emery dust is either marketed in its pulverized form for polishing purposes or made into one of the emery products, stone, paper, or cloth. The stone is made by combining the dust with clay and baking it, the paper and cloth by spreading it upon the surface desired, which is first coated with glue.

HOW DYNAMITE EXPLODES

A great many persons entertain the notion that, in exploding, dynamite seeks "the line of greatest resistance." They know that if a quantity of black powder be placed upon a rock and lighted by a fuse, it will simply flash, scorching the stone; and that if a bit of dynamite be exploded on the same rock, the rock will be shattered. Hence the conclusion, quite erroneous, has been reached that dynamite follows the line of greatest resistance. Nothing could be farther from the truth than this. The black powder ignites and explodes much less rapidly than does dynamite, with the result that the force of the powder is soon dissipated in the atmosphere surrounding it. In the case of dynamite, however, the explosion is so sudden, "the attack upon the air" so instantaneous, that, for a fraction of a second, the air actually resists. The force of the dynamite is so tremendous that it is turned into the rock, which, for the instant, becomes the line of least resistance.

An illustration of all this may be seen in lightning discharges. A fork of lightning streaks across the sky. It packs the air so densely that it can no longer make rapid progress in that direction; so it turns aside to follow the line of least resistance. It "cannot wait for the air" to yield. The same is true in the case of dynamite.

SMALL ALTERNATING CURRENT MOTORS

How to Make a Compensated Series Motor of One-half Horse-power for Single-phase Circuits.*

By A. E. Watson, E. E.
Professor of Electrical Engineering in Brown University, Providence, R. I.

Illustrations from drawings made by the author.

THE motors thus far described have been inherently of the constant speed type. While in some cases some variation from the normal speed is possible, it is usually at the expense of efficiency. As long as the induction principle is involved, the only satisfactory speed is that which aims towards synchronism with the generator.

It is certain, however, that many applications of electric motors demand a variable speed, and that over a wide range of such operation the efficiency shall be reasonably high. It is curious that in the solution of this construction recourse should be taken to certain principles found in the very first motors that would operate on alternating currents, namely, the series type. As long ago as 1888 motors of this sort were made, but only in small sizes. It was observed that while such motors, if made with laminated field magnets, would run, it was accompanied with such destructive sparking at the brushes as to be intolerable. The substitution of carbon for copper brushes improved matters a little, but even then the construction was regarded as practicable only for such small sizes as were applied to driving fans and sewing machines. The discovery of the induction principle in 1891 led at once to the discontinuance of the manufacture of such series motors.

For more than ten years after this not a series alternating current motor was made, but with the demands of heavy or long distance railroading, inventors began to ask if, after all, there was not a chance for this type of motor. At first the proposals were discounted as visionary, for if the construction was impractical for a fan motor what chance could exist for one of a hundred or more horse-power? While some problems in electric traction can be regarded as by no means yet solved, the production of effective motors operating on single-phase currents, and adopted on numerous railroads in various parts of the world, is one of the most notable accomplishments of present-day engineers.

The two serious shortcomings of the series alternating current motor were its sparking and small output. Actual heating of the iron from the rapid reversal of the magnetic flux was readily overcome by laminating the field structure as well as the armature, but while the sparking might perhaps be reduced to less destructive character, the fact that a large and expensive structure would yield only one-half the power of other sorts promised to be a permanent handicap. This small output is due to what is technically denoted as a poor "power-factor"; that is, the current is far out of step with the voltage. It is interesting to note that the final means adopted to improve the power-factor were also vital for sparkless commutation. In order to make clear the description of the special winding for the motor to be described in this article, a review of certain principles associated with electric circuits may well be brought in.

When a current flows through a simple coil of wire that embraces iron, a magnetic condition is established. In many cases this is the very result desired, as for example, in a field magnet. The more magnetism produced, the better. In certain cases, however,

* This is the last instalment of a series that has appeared in every issue of MODERN ELECTRICS AND MECHANICS from February to July, 1914, and in every issue of POPULAR ELECTRICITY AND MODERN MECHANICS to date. Back numbers may be secured at 15 cents each while the supply lasts.

where the coil and the iron are present, the magnetism may not be desired. In such cases as resistance coils in electrical measuring instruments, while iron may not really be present, still a small yet undesired magnetic flux may be established. The condition can be avoided by winding the coils "non-inductively," by which is meant that one path of the current is intimately associated with another part conveying the same current in the opposite direction. Evidently the magnetizing effect of one will just neutralize that of the other. It is really no more difficult to wind the coils with this qualification, for it is only necessary to loop the wire in the middle, and to wind towards both ends, or for longer lengths, to solder together the wire from two different spools, then to wind coincidently from the two rather than from a single one. Finally, both ends will be on the outside, thereby allowing convenient connection to binding posts. Now, current flowing in by one wire will be ex-

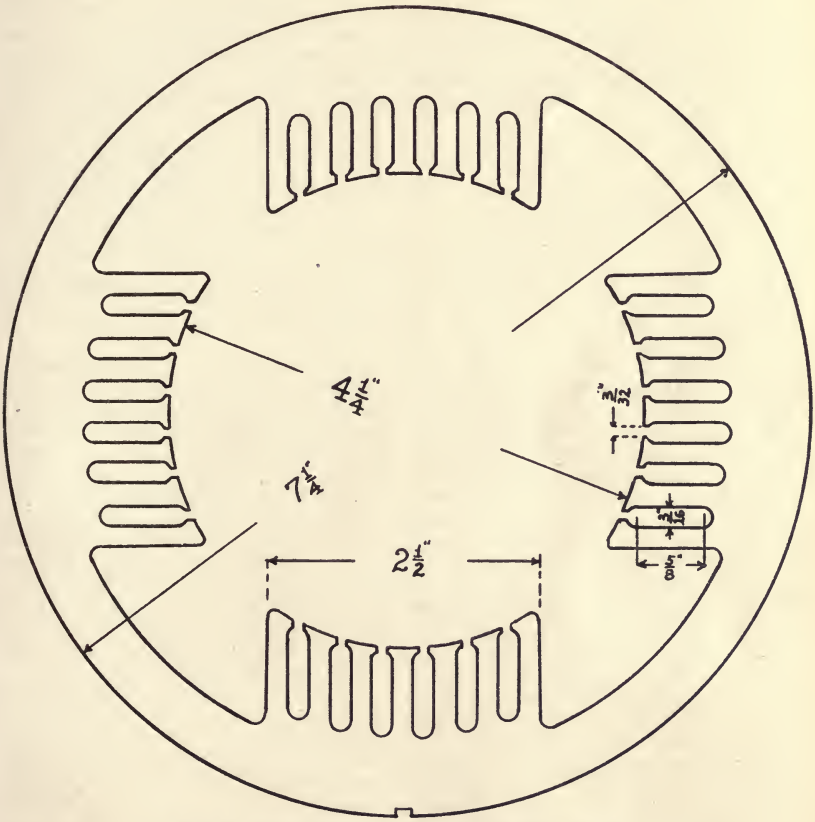


Fig. 45.—Field Punching for Compensated Series Motor.

actly parallelled by an opposite current in the other wire. The attitude of such a winding towards alternating currents proves its difference from the ordinary, or inductively, wound coil, for while such currents find great obstacles to their passage in the latter, they will flow through the other quite in keeping with Ohm's law.

The application to the case of the armature of a motor can now be foreseen. Any such definite winding is inherently inductive. This can be proved by taking any direct currrent armature quite apart from its field magnet, and sending through it, by means of contacts at the positions normally occupied by the brushes, any suitable strength of direct current. The iron core will exhibit poles at as many places as there are such points of contact. With a ring wound armature, contact can be made to illustrate any desired number of brushes, but a drum armature, of course, is wound to fit some particular number of poles, and hence cannot be used in any other than one way. Direct current will flow in such a winding quite in obedience to Ohm's law. Now, if alternating current be sent through the winding, quite a different result will be experienced, for even though many times the former voltage be used, the actual current may be decidedly less. The reason is found in the fact that the winding really constitutes a choke coil, and that the impedance to the passage of alternating currents may readily be many more times as large as the resistance.

To have prevented the direct current from establishing a magnetic field, there might have been employed a sort of stationary cage of windings to surround the entire armature, so arranged that every wire of the regular winding would be paralleled by one of the cage but conveying the same current in the opposite direction. Then, if in one place the current were trying to establish a magnetic field, it would at once be offset by the same currrent flowing in the opposite direction in the neighboring wire. The crucial test to apply to such a winding is to submit it to alternating currents, when, if effective, no greater voltage will be required than for the direct current case.

At first thought it may appear impossible to apply such counteracting windings to the armature already embraced by the field magnet, but space for such is found in the face of the pole pieces themselves. By cutting narrow slots with still narrower openings space is found for the wires, and these must of course provide for as many or even more ampere-turns than the armature itself exerts. Another suspicion may occur to the reader—that such windings may nullify the rotational powers of the armature winding. The force to rotate the armature wires is really due to the main flux set up by the regular field winding, and the only additional effect on the compensating winding, since it is cut by the same field flux, would be to exert upon it a rotational effect in the opposite direction, but being securely located in the slots, it is unnoticed.

Really the scheme of the compensating winding is not new, for it has frequently been applied to direct current machines, purely to prevent the necessity of shifting the brushes under change of load, a result now more cheaply attained by use of "interpoles." These latter, however, correct the armature magnetism in but narrow belts, and not over its entire surface as is required for the more complete suppression of sparking. Turbine driven direct current generators have even been made with both interpoles and compensating windings.

With the armature self-induction thus eliminated, whereby the operation will be dependent, as desired, purely upon the counter electromotive force due to rotation, the next factor to consider is the field winding. To make it non-inductive would clearly be a contradiction of terms, for by a field winding is meant one that is inductive, and the other expression would mean no field at all. At best, the self-induction of this member can merely be made of small amount. As the only hopeful recourse, since self-induction increases as

the square of the number of turns in a coil, there will be advantage in winding the field of the motor with relatively few turns, therefore for low voltage. Although the supply will not ordinarily be at a presssure lower than worth the extra cost and labor involved.

Possibly some wonder may be felt as to why a shunt winding has not been proposed. From the considerations just expressed it will be clear that such a winding, with its numerous

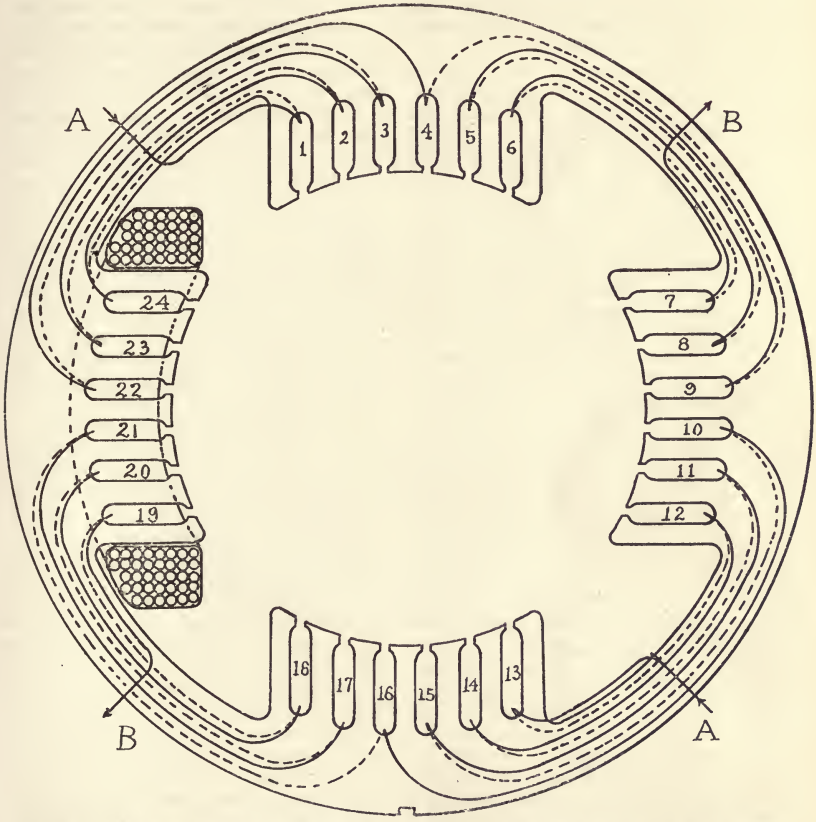


Fig. 46.—Diagram of Compensated Winding for Series Motor, showing also One of the Regular Field Spools in Position.

100 volts, it is here recommended that a pressure of about 30 volts at the motor be provided. This will require the use of either a two-coil transformer or an auto-transformer, but such devices waste almost no power, and the gain of the low voltage will be well turns, would have an exceedingly high self-induction, therefore permit practically no alternating current at all to get through it. Further, what little current might get through it would flow at the wrong time to be useful. The lag would be nearly 90 deg., there-

fore quite inoperative on the armature, for first there would be current in the armature, but no field magnetism with which to act; then there would be a little field magnetism, but no current in the armature. This out-of-step fatality is perforce absent from the series motor, for if current flows through one member of the machine it does so coincidently with the other.

With the acceptance that a series field winding is the only sort permissible with such a motor, and next that a low voltage is desirable, the sort of armature winding to be provided must be decided upon. Whereas for the repulsion motor, in which an odd number of slots was advantageous, a series, or 2-circuit armature winding was described, for this case a multiple winding, requiring four brushes, will be best. About 20 amperes may be employed for full load, therefore a liberal size of commutator and the contact of four brushes will be none too much.

The most prolific cause of sparking in an alternating current "commutator" motor, especially at the instant of starting, is due to the transformer action experienced by the coil undergoing commutation. At that instant the brush bridges across two segments, and the maximum value of the alternating flux will be threading through the coil attached to them. A very large current will then flow, quite likely larger than the main operating current, which rapidly heats the coil; then as rotation takes place, this large local current will be broken at the tip of the brush, resulting in a flash of quite destructive nature. Continued action of this sort will rapidly destroy the copper. If such a load is applied to the motor that it cannot readily start, the prolonged current in this short-circuited coil will be liable to burn it out. There is a feeble current of this sort constantly produced in a direct current dynamo, but the electromotive force being merely due to the inexact setting of the brushes, as regards the neutral region, sufficient resistance to reduce the current to a negligible degree is offered by the carbon brushes. With an alternating field flux, however, the case is serious, and even hard carbon brushes are quite ineffective. Since for readily conveying the large current good conducting carbon or graphite must be used, a remedy must be sought in some other direction. This is found in the expedient of employing high resistance leads between the armature winding and the commutator. Then, in order to complete its circuit, this undesired current will be compelled to travel through two such links in series. Since only those leads are concerned which connect to the commutator segments making contact with the brushes at a given instant, the internal resistance of the armature as a whole is not thereby seriously increased, therefore the efficiency of the motor is not noticeably impaired. A further step towards elimination of sparking will be made if the number of coils and commutator segments be made as large as possible, the electromotive force generated in any one coil thereby being a minimum.

With these various considerations relative to the principle of operation of a series motor described somewhat at length, but presumably in a convincing manner, certainly well verified in practice, the modifications over former published designs can readily be stated and comprehended. For the provision of a definite line of commutation, a field magnet somewhat resembling that for a direct currrent machine will be advisable. In order to prevent the flow of eddy currents, the structure must be of thin sheet iron and well separated by use of tissue paper or varnish. Armature self-induction should be neutralized by a compensating winding. Field magnet should be series wound, there being gain in the adoption of a low voltage, with consequent requirement of but few turns. Although mention has been made of the voltage, no reference has yet been made to the speed. Since a series motor is being described, inherently adapted for variable speeds, no principle of synchronism enters, so by applying suitable voltages, almost any

speed within wide limits may be utilized. By making the secondary of the special transformer with numerous taps, as many different voltages as desired may be readily available.

In Fig. 45 is shown one of the sheets for the field structure. The builder will find it awkward to make, and for constructing a single machine, for which the making of punch and die would be a disproportionate expense, ing shown in Fig. 33 of the August number of the magazine may well be used, the dimensions for the shaft and core being obtained from Fig. 32. In place of the collector rings described in that article a liberal size of commutator, such as was shown in Fig. 42 of the December issue, though with 24 rather than 23 segments, will be required. Still better would be 48 segments, with two coils per armature

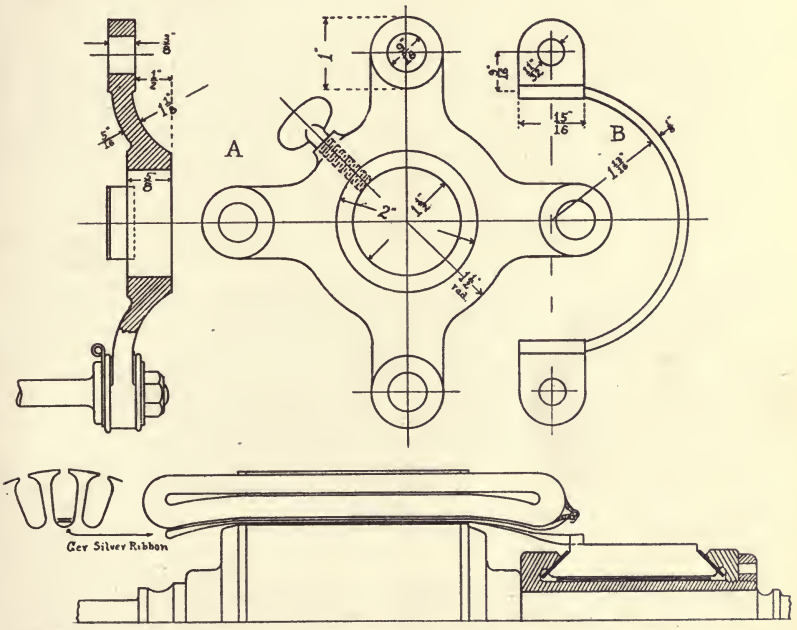


Fig. 47.—Details of Brush-holder Yoke, Cross Connector and Commutator Resistance Leads.

recourse may be necessary to drilling, sawing, and filing methods. Since the magnetic density is to be at a lower value than for the induction motor, a small cross-section of the outer ring, or yoke, portion will be entirely sufficient. Some modification will consequently be necessary in the width of the flange and ring used for clamping the sheet iron within the cast iron frame.

For the armature the 24-slot punch- slot. The brush holders and spindles of these same articles may be copied. A four-ended brush holder, with cross connections for the spindles, as shown in Fig. 47, will complete the list of special parts.

After assembling the field structure with its end-sheets of fiber as in preceding cases, the polar slots being filed out smoothly and insulated, the compensating winding is first to be placed, and this will consist of four No. 14

wires in parallel, fumbled in place through the narrow openings, quite in the manner employed for stator coils. If preferred, the builder may wind each of these four groups with a single wire, then finally connect the four separate coils in parallel with each other. The actual disposal of the wires will present some difficulty. Space for the regular field windings must be reserved, so these extra coils must be bent back and around out of the way. Reference to Fig. 46 will indicate the method to be followed. One of the coils may be imagined as beginning at "A," and passing through slot 1, then directly back to the inner diameter of the clamping ring, thence to slot 24, back to slot 1, and so on, until as many turns as possible, say four or five of the bundle of wires, have been placed, then into slots 2 and 23, finally in slots 3 and 22, each successively larger spread of the coils requiring disposal at a greater distance from the center. Without cutting the coil, continuance may be made, if the builder chooses, into slots 4 and 9, then 5 and 8, 6 and 7, the end being at "B." Since this order will require the largest radius to be first used, the builder will decide for himself whether this can readily be accomplished. A similar start is to be made in slot 13, ending at B' from slot 19. By connecting A' to B the two groups will be put in series, then the other ends attached to terminals on the connection board.

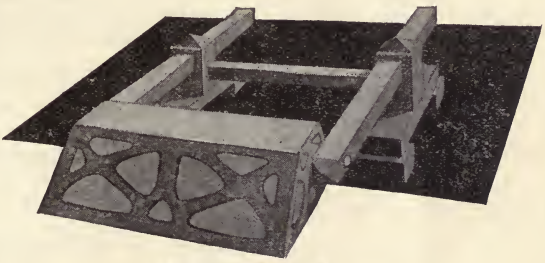
After these coils have been placed, the space remaining for the regular series coils may be seen, it being a good provision to make a sheet metal or cardboard templet that will readily pass over the pole pieces and their protruding windings, then to make the winding-form sufficiently large to fit them all. If a single wire is to be used it should be No. 8 in size, and then all four coils are to be connected in series. If preferred, No. 14 may be substituted, and the coils connected in parallel with each other. In either case the wire is so stiff as to preclude the possibility of bending the coils after they are wound, so the shape to fit the curvature of the polar bore must be introduced into the winding-form itself. Cotton tapes laid in the form before the winding begins can be used to hold the coil together while substituting the final covering. The two ends of the field winding may be led to two special terminals on the connection board.

For the high resistance leads of the armature, thin ribbon of German silver, say 3/16" or 1/4" wide, and .02" thick, in strips about one foot long, with well tinned ends, are to be provided and insulated with varnished cambric. Each should then be doubled in the middle and laid in the bottom of the insulated slot, the open end being left for the connections as shown in Fig. 47. After placing the coils, which may well be of No. 16 wire, wound quite in the manner of any direct current armature, their ends are to be joined in the usual method for a multiple winding. While these protruding ends may be joined by use of fine wire and solder, they are also to be further secured by bending around them and soldering one end of each of the ribbons. The other ends of the ribbons are to be given a twist and soldered into sawcuts in the commutator segments.

To provide for the cross connections of the opposite brush-holder spindles, sheet copper ends joined together by soldering a 1/8" diameter brass wire makes a simple and light structure. Two such are needed, one being located on the inside surface of the yoke, as seen in the figure, the other, joining the other two spindles, being just outside the yoke. By this means ample clearance is obtained. Flexible cables are to join each set of spindles with terminals on the connection board. Since there will be in all six terminals —two from the main field winding, two from the compensating winding, and two from the armature, and ready means should be adopted for connecting them as desired, a good plan will be to have a fiber block on each side of the machine, each fitted with three binding posts, one for each circuit. These posts should be of generous size.

A Lamp for the Piano*

A PIANO lamp of pleasing and practical design is depicted in the wash drawing. The realization of both of these qualities is seldom found in a lamp of this type, for it is not infrequently the case that practical utility is sacrificed for the sake of artistic effect or *vice versa*. The design offered herewith will produce a lamp that may be adjusted to clearly illuminate the sheet of music while completely shielding the faces of the musicians from the direct rays of light; at the same time, the lamp will prove an inconspicuous ornament on the top of the piano.



View of Completed Piano Lamp.

The lamp is made of a wood to match or harmonize with that of the piano case; the stock should be ordered planed and sanded to the required width and thickness and the builder will then have only to cut to the proper length, square up the ends and assemble. The dimensions of the various parts comprising the lamp are given in Fig. 2, and the complete bill of materials is as follows:

(*A*) 2 pieces 10″ long, ⅞″ square.
(*B*) 2 pieces 13¼″ long, ½″ diameter dowel rod.
(*C*) 2 pieces 3″ long, 1¾″ square.
(*D*) 4 pieces 2″ long, 2″ wide, ⅞″ thick.
(*E*) 2 pieces 6″ long, 1¾″ wide, ⅞″ thick.
(*F*) 1 piece 11½″ long, ⅞″ square.
(*G*) 2 pieces 10″ long, 5″ wide, ⅛″ thick.
(*H*) 1 piece 10″ long, 2″ wide, ¼″ thick.
(*I*) 2 pieces 4⅝″ long, 4½″ wide, ¼″ thick.

In addition to the wooden stock enumerated above, the builder will require two pieces of art glass, 9½ inches long by 4½ inches wide and two pieces cut to the shape and size of the end pieces *I*, Fig. 2. An electric lamp key-socket, bushing and flexible cord with plug attached will also be required. The lamp socket is mounted as shown in the drawing at *J*. This mounting requires a strip of ⅛ inch sheet metal bent into an L and drilled with a hole to pass the socket bushing in the long portion and to take the round-head screws in the foot.

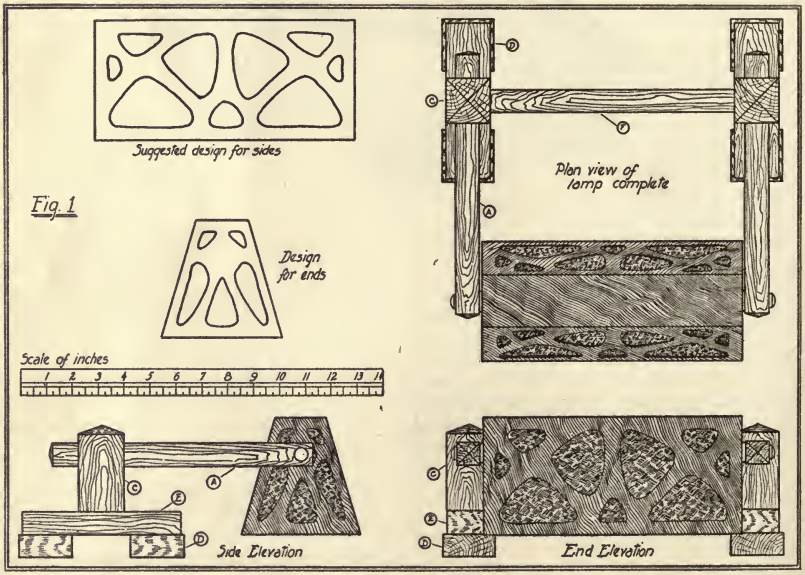
Having provided himself with the necessary stock of materials, the builder may proceed to prepare them for assembly. With reference to the pieces *A*, the hole for the dowel may be bored through each and the ends pointed as shown in the drawing. The pieces of dowel, *B*, require no description save that one end

* This article is one of a series that appears regularly in this magazine, describing the construction of lamps of many different designs.

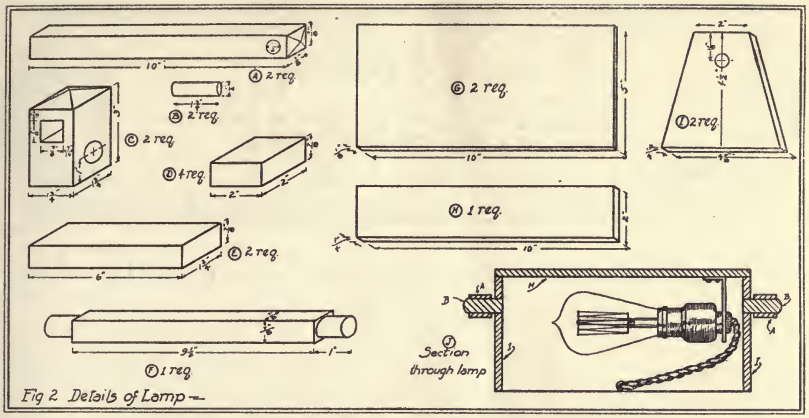
of each is rounded off. The posts *C* are pointed at the top and the hole in each is bored one inch deep with a ¾ inch bit to take the round portion of the spreader *F*. The square opening is chiseled entirely through each post to take the piece *A*. The pieces *D* and *E* require no comment other than that a hole is bored in each of the D pieces in order that they may be loaded with melted lead so that the lamp will not tip over when assembled. The hole in each piece should be as large as it can be made without splitting the wood.

The piece *F* is doweled at each end as shown in the drawing and the diameter of the rounded portion should be a full ¾ inch, in order that it may be a tight fit into the hole in the piece *C*. The side pieces *G* are of thin stock suitable for scroll saw work and in Fig. 1 is suggested a design for the side of the lamp as well as one for the end pieces *I*. The latter are of heavier material than the sides, as the reader will note. The top piece *H*, is likewise of ¼ inch stock.

After the design has been cut out of the sides and ends, the builder may proceed with the assembly. The top piece of the lamp shade is to be secured to the ends with glue and very slender brads and its edges given the proper bevel in order that the sides will fit nicely when they are adjusted in position. The latter are likewise secured with glue and brads. The art glass may next be placed in position within the shade and in this operation the builder will require a few strips of thin wood. The lamp socket may then be affixed and attention given to the base of the lamp. Reference to the various drawings in Fig. 1 will make this assembly quite clear. The feet *D* are secured to the pieces *E* with glue and nails after they have been filled with lead as mentioned previously. The posts *C* are either nailed or screwed, preferably the latter, to the bases and the spreader rod *F* is secured with glue as the complete base is set up on a flat board to insure perfect alignment of the various parts. When the base has been assembled and the glue dried, the shade may be suspended between the arms *A*



Drawings of Completed Lamp showing Method of Assembling.



Details of Parts of Piano Lamp.

by passing the short dowels *B* through the holes in the arms and into those in the ends of the shade.

The woodwork may be finished in any manner desired and it is only necessary to suggest that the staining and varnishing should be done before the art glass has been put in place.

HOW GOLD LEAF IS MADE

The metal worked by the "gold beaters" comes to them in wide bars or nuggets. It must be weighed, melted and made into inch-wide ribbons before the beating begins. The ribbon is then cut into inch squares and beaten with a hammer wielded by a stalwart workman. When each leaf has been beaten thin it is transferred to a mold, where it is beaten again for a period of four hours. The beating is accomplished by means of a wooden hammer weighing from seven to eighteen pounds on a sheepskin cushion resting on a granite block.

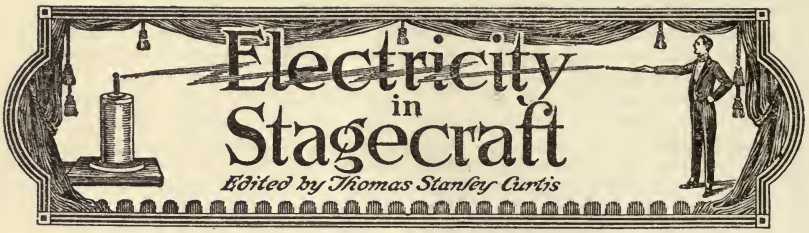
The gold beaten is usually twenty-two or twenty-three karats fine. A little alloy of copper or silver is added to make it spread. It would be impossible for the beaters to handle absolutely pure gold.

Gold leaf is packed more by the aid of the breath than that of the hands. The operation of transferring a sheet of almost transparent gold leaf from one place to another is of such delicacy that it is possible to accomplish it only by a slight puff of the breath. The packers are, for the most part, girls to whom, after the beating of the gold, the leaf is handed.

The girls lift the unshaped leaf from the mold with a pair of wooden pincers, flatten it out on a sheepskin cushion by gently blowing on it, cut it into a perfect square, place it between the leaves of the book, and flatten it out with the breath. A book consists of twenty-five leaves, and a skilled operator can pack seventy books in a day.

THE BEEDLE FAN

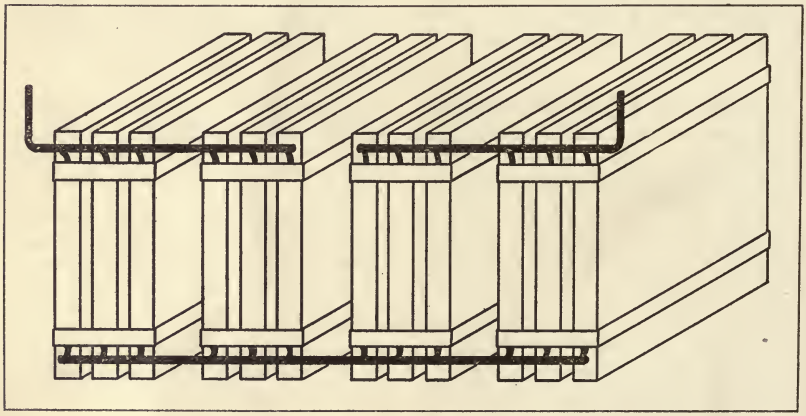
This is an English invention, in which the revolving blades are made with curved surfaces, of a peculiar form, which impel the air in a direction parallel to the axis of the fan. It is said that virtually the whole power is utilized in making the air "travel," and very little in simply churning it up. It is believed that the invention may find practical application in the propellers of ships and aeroplanes.



Apparatus for a Spectacular Vaudeville Act*

THE present article, which deals with the high tension condenser to be used in connection with the apparatus previously described, is the concluding instalment of the series on the making of the high frequency transformer outfit. The next instalment will be devoted to detailed instructions for setting up and operating the apparatus covered in this and preceding articles. Subsequent numbers of the magazine will present the constructional features of various other instruments and devices to be used in the presentation of an up-to-date electrical act for the stage.

Before proceeding with the description of the condenser, it may be well to state that this particular feature of the outfit presents many difficulties in its design in view of the fact that the condenser is to be subjected to much rough handling and moving about. The data offered herewith is for a condenser having glass plates for its dielectric, but the author would suggest that this material, while highly satisfactory for use in a condenser to be used in but one place, is obviously subject to breakage and is at a further disadvantage from point of weight. Its use is suggested in the present paper merely because the stock is readily obtained and this at a low figure.



Complete Condenser, Showing Method of Connecting.

* This article is one of a series that has appeared in the September, October, November and December issues of POPULAR ELECTRICITY AND MODERN MECHANICS.

Sheet mica, while several times as costly, is far superior in every way and its use is strongly recommended to those who feel that the extra expense is justified by the advantages gained.

For the condenser proper, 120 sheets of 8 by 10 inch photographic glass will be required. This glass, in the form of discarded negatives, may be obtained from almost any photographer for a small sum. In addition to the plates above-mentioned, the builder will require some 24 plates additional to serve as cover glasses for each condenser unit. A few extra plates to replace possible broken or defective ones will not be amiss.

The first operation will be to clean the emulsion from the glasses and this is readily done by soaking the plates in hot water. It is not essential that the plates be made perfectly clean of the emulsion if the plates have all been developed and the silver dissolved, but it is desirable to get the surface and particularly the edges for a space of an inch or more as clean as possible. The plates, when cleaned and dried, are to be placed in a warm oven prior to having the metallic coating of tinfoil placed on each side.

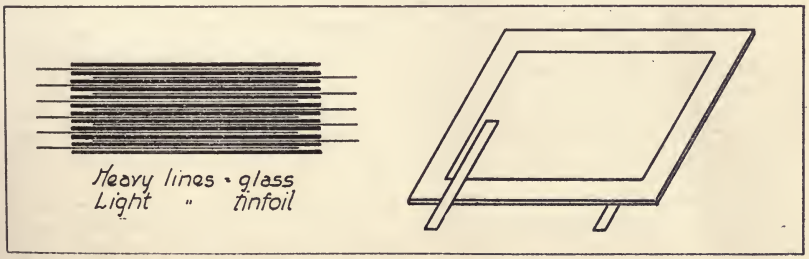
This coating is of the heavy foil used by florists and may be obtained in strips 48 inches long and 6 inches wide at almost any florist's shop. It comes in packages of one pound and averages some five strips to the package. The foil should be straightened out and cut off into rectangles 6 by 8 inches in size in order that when secured to the glass it will leave a margin of an inch all around.

The condenser is made up into units of ten plates each and each plate is to be coated on both sides with the tinfoil. In all there will be 12 units connected up as shown in Fig. 13, that is, two sets of six units each connected series-multiple.

To coat the plates the builder should provide a lump of beeswax and a "pounce" made by enclosing a wad of cotton within a soft cloth. A warm plate is taken from the oven and laid upon a cloth-covered table top. The lump of beeswax is rubbed lightly across its surface to provide a thin and even coating. A sheet of tinfoil is immediately placed in the centre of the glass and rubbed into close contact with the pounce, starting at the centre and, with a circular motion, working out toward the edges. This will result in a perfect union of glass and foil at all points. The plate is immediately reversed and the other side coated in like manner before the plate gets too cold to melt the wax. The remainder of the plates are to be treated in a similar manner when they are ready for the connecting lugs, after having had their edges dipped in melted wax far enough to cover the edges of the foil for a space of an inch or so to prevent brush leakage.

The lugs are of thin copper ribbon, tinned at one end and affixed electrically to the tinfoil at alternate ends on both sheets of foil with a deft application of the soldering copper. A little practice on a scrap plate will soon enable the worker to master the operation of soldering the copper to the foil without

(*Continued on page* 120)



Showing Method of Assembling Plates of Condenser with Lugs Projecting. Also View of Single Plate of Glass with Tinfoil in Position.

Practical Electro Therapy

Edited by Thomas Stanley Curtis

Application of Various Currents*

WE have learned in previous articles what the various kinds of electric currents are, how they are produced and, in a measure, how they are applied. In the present instalment, the application of the high frequency or oscillatory electric current will be under consideration. An explanation of the characteristics of this form of current was given in the October number of this magazine as were also suitable analogies illustrating the principles of electromagnetic induction. The matter will, therefore, not be reiterated here and it is assumed, in offering this article, that the reader is familiar in general with the action of alternating electric currents.

In the accompanying illustration, Fig. 15, a diagram of an oscillatory circuit is given. At the left, the reader will note the primary of a high tension transformer. This instrument takes the alternating current from the line wires at the voltage commonly employed for lighting purposes and steps it up to a value of perhaps several thousand volts on the secondary or right hand side of the first figure in the drawing. From this point on, the reader will see the true oscillatory circuit which comprises a spark gap, represented by the two small circles, the condenser, represented by the heavy black lines, and the primary of a high frequency transformer at the extreme right in the drawing.

The condenser is a device for storing electric energy at high pressure or voltage and in this diagram it is shown in such a position that it will take the high voltage from the secondary of the transformer and store it up until the pressure becomes so great that the current leaps across the spark gap in a succession of crashing discharges. While this discharge occurs, the current is surging back and forth through the circuit of the condenser, gap and primary of the high frequency transformer at a speed or frequency of perhaps hundreds of thousands of times per second. This high frequency current will be maintained in the circuit as long as current is supplied to the primary of the low frequency or step-up transformer for the latter instantly restores the charge in the condenser as fast as it discharges through the oscillatory circuit. The current in this circuit is flowing at approximately the voltage of the transformer secondary and for certain purposes in electro-therapy, it is desirable to employ a much higher potential. This desirable feature is readily obtained by applying the transformer principle once more and adding a secondary coil of many turns of fine wire to the primary coil of the high frequency transformer. In this case, however, no iron core is used, for its employment would retard rather than assist the transformer action where high frequency currents are involved. The top of the secondary winding is connected with a ball discharger from which sparks may be drawn or to which the connecting cords leading to electrodes may be attached.

The high frequency current is finding a most important place in the field of electro-therapy at the present day and its use in many of the familiar ailments has

* Continued from the December issue of POPULAR ELECTRICITY AND MODERN MECHANICS.

proven very beneficial. The current possesses the most peculiar properties and while a thorough discussion of its characteristics from a medical standpoint cannot be given in the present article owing to lack of space, still it is believed that a mere sketch of some of its interesting points will not be out of place.

Many years ago it was learned that if an alternating electric current be increased in its frequency to a point far beyond that used for commercial purposes, the current could be applied to the human body at voltages that would ordinarily cause serious shock or perhaps death. By increasing the frequency of the current beyond 100,000 cycles per second, the current was rendered practically painless when applied to the body and its presence was not accompanied by the characteristic muscular contractive effects of the low frequency alternating and the direct currents. This discovery practically revolutionized medical electricity as it permitted the investigators to make bolder strides into the future and to bring to light many facts of inestimable value to modern electrotherapy.

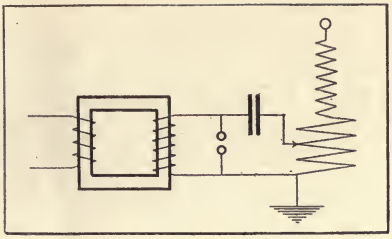


Fig. 15.—Diagram of an Oscillatory Circuit.

A FREAK OF LIGHTNING

A vivid flash of lightning closely followed by a sharp clap of thunder and a report from the switchboard like a pistol shot, startled the telegraph operator and other clerks who had just reached the office and were getting books and reports in readiness for the day's work.

The cashier turned to the safe, as he had done every morning for months, and began to twirl the knob, setting it on the numbers which had opened it hundreds of times. He was astonished when it did not open the first time and after repeated failures, called the agent. Numerous draymen were waiting at the window for freight bills, and the bills were in the safe, which could not be opened on the combination that had so long been used without a hitch.

The cashier made duplicate bills from office records and cleared the office of draymen while the agent continued his efforts with the lock without result. Finally he decided on a system. Knowing the lock contained three tumblers, he used the old numbers on all but one, skipping to the next figure and repeating this with each tumbler, but still it would not open. He was about ready to wire the superintendent for authority to have the door drilled open, when he decided to try it once more, and using the first and last figures of the combination and a new figure for the middle tumbler, the bolt clicked in the notches and the door was opened.

On examination it was found that lightning had struck the safe doing no damage except to knock loose a spring that held a shoulder in position on the middle tumbler, leaving it free on the stem of the knob. It was only by mere accident that the middle tumbler was stopped in the right place on the last trial.

The propellers of aeroplanes such as are used in the present European war may be made of selected ash, which is both strong and light and will not split under vibration or shock, or of built-up layers of spruce with mahogany centers. The framework of the machines, too, is generally made of wood, spruce being much used on account of its straight grain and freedom from hidden defects.

Electroculture Shows Good Results

THE latest reports from experimenters who are carrying on research in the electrical stimulation of plant life in various parts of the world offer conclusive evidence of success. In practically every experiment the period of maturity has been notably lessened, while the quality of every crop treated has been greatly improved.

More to the point, however, is the fact that the yield has been increased without exception. In one case reported, the increase was just about 40 per cent. in a plot of electrically-forced strawberries, as against an adjoining plot untreated. In the same test, beets were increased in yield 30 per cent., cucumbers 19 per cent. and tomatoes 20 per cent.

However, the increase in profits to the commercial producer does not lie so much in the matter of greater yield as in the advanced maturity which places the product on the market earlier and so commands a higher price. A peck of tomatoes in advance of the regular season when the market is not overstocked, is worth more in net profit than a barrel later on when every tomato field is sending fruit to the market by the ton.

In a recent Chicago truck garden experiment, posts eight feet high were set twelve feet apart about the plot to be electrified. From these posts wires were stretched taut both ways, making overhead squares twelve by twelve feet. The network of wires was electrified in the manner described in recent issues of this magazine.

A report made for the first year of the experiment shows that although the season was unusually dry, all of the vegetables and farm crops planted in the electrified area developed an unprecedented growth even when compared to favorable weather conditions by the ordinary method.

As an example: musk melon seeds planted the eight of June ripened in a little over eight weeks and with such remarkable evenness that all the melons were marketed in six days. The yield was 365 perfect melons from a plot twenty feet square or over 40,000 per acre. But even of more importance than the heavy yield of salable fruit, was the fact that they were on the market before other local melons, and as they matured in a few days they were all sold before ordinary stock came on the market.

In all of the experiments reported it was found that fruit, vegetables and flowers grew faster, to a greater size and of a better quality, when thus fertilized with electricity. Those who have applied the electrical treatment in crop production find their crops mature about a month in advance of the ordinary season.

APPARATUS FOR A SPECTACULAR VAUDEVILLE ACT

(*Continued from page 117*)

melting the latter. The drawings in Fig. 14 illustrate the location of the connecting lugs and also the way in which ten plates are piled one on top of the other to form a complete unit. This assem-

bling having been done with the entire lot of plates, the projecting lugs may be clamped with the pliers and soldered to short lengths of copper ribbon ready for connection with the bus-bars of the condenser. The plates of each unit should be bound with tape to afford mechanical strength and ease of handling. A plain piece of glass is placed on either side of each unit under the binding tape.

The twelve units are to be assembled in a strong wooden case and each unit should be separated from its neighbor by strips of wood covered with felt. Connections are made as shown in Fig. 13, to bus-bars consisting of several strips of copper ribbon fastened together. The connections with the outside of the case are by means of heavy flexible cables made by binding a number of strands of fine insulated copper wire under one cover as described in a previous article.

A SLOT MACHINE FOR NEWSPAPERS

After all the devices to which we have been accustomed in the various slot machines, not only for making sure that the wares will not be delivered until a coin has been inserted, but to reject all coins that are not the proper denomination as well as all slugs, we are indeed surprised at the simple innovation of a Greek lad in San Pedro, California. He goes so far in showing his trust in the public that he has established racks of wire on the telegraph and electric light poles at the main corners of the town, so arranged as to hold a number of newspapers in such a position that the upper half of the front page may be read by all who pass, thus arousing their interest in the contents of the rest of the columns hidden from view. The purchaser merely drops one cent in the slot in a small red leather box attached to the pole just above the rack.

At first the trustful Greek did not even have a lock on the small boxes, but the raids of the small boys of other denominations soon reduced the funds in the "slot machines" faster than he could get around to collect them. It is a fact—and one that has caused much comment—that few people try to cheat the boy who has inaugurated this convenient and silent system of selling papers, either by taking the papers without even making a pretense of putting in a coin, or by pretending to slip a penny into the slot. If all of our papers were sold on this system of trusting the public we would not be bothered with a great amount of shouting on the streets.

ELECTRIC EQUIPMENT OF THE PANAMA CANAL

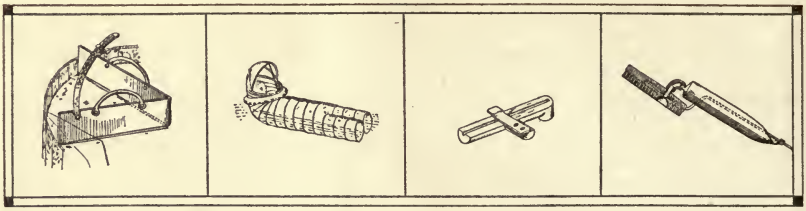
Nearly two thousand special drawings were required in the fabrication, and there were also involved the following unusual quantities of materials in the electric equipment of the Panama Canal:

Special slate bases	1,300
Small castings	160,000
Screw machine parts	1,200,000
Copper rod and bar	58,000 ft.
Asbestos lumber	9,000 sq. ft.
New patterns	650
New jigs, templates, tools, etc.	625
Porcelain parts	18,000
Special bus supports	6,800
Gal. pipe (framework)	21,000 ft.
Special gears	2,390
Special instruments	640
Miscellaneous sherardized pieces	300,000
Cases for boxing	4,150

The combined weight of the centralized control boards for Gatun, Pedro Miguel, and Miraflores is about 39 tons. In their construction there is employed:

More than 2¼ miles of interlocking rod;
About six million feet of control leads—made up in 5 and 8 conductor cables;
732 indicator motors;
464 control switches.

All of the lock machinery motors, control panels, centralized control boards, power station generating apparatus, switchboards, transmission line substation equipments, coaling stations, and practically the entire electrical equipment for the wharf terminal cranes and for the extensive permanent repair machine shops were manufactured by the General Electric Company.



Recent Novel Patents

Apparatus for Cutting Butter

One of the most unique patents that have been granted within the last few months is an apparatus for cutting butter. It consists of two hinged members sharpened on one edge and fitted with handles. The two members can be so spaced as to form any desired angle and held in that position by a connecting member.

Life-Saving Apparatus

Of the many inventions for life saving at sea, that of a New York inventor is among the most interesting ones. As shown in the illustration it is an odd shaped suit that is worn by persons to enable them to float in the water. A life ring is placed around the neck portion to prevent the suit from capsizing. The head of the wearer is held above water and is protected by a hood.

A Needle Threader

In one of the accompanying illustrations is shown a simple needle threader that has been patented by an Oklahoma inventor. It consists of a member that has a groove on one side in which to place the needle which is then firmly held by a springy metal strip; the thread being passed through a hole in the back of the member and passing through the eye of the needle held in the groove. Of course, the walls of the hole gradually converge as they approach the eye of the needle.

Cream Massage Device

In order to facilitate the application of massage cream, a Chicago inventor has patented the device shown in one of the sketches. It consists of a massage member to which is connected a collapsible massage cream container by means of a tube. As the massage member is employed on a patient's face, a slight pressure on the collapsible tube supplies the cream in any quantity desired.

Pineapple-Eye Snip

A New England inventor has been granted patent rights on an implement for removing the eyes of pineapples. As shown in the illustration, this device is very much the same as a pair of ordinary pliers, with the one exception that the jawlike portion is sharpened so that the two members can be pushed into a pineapple and then brought together in order to remove the eye.

A Drinking Cup

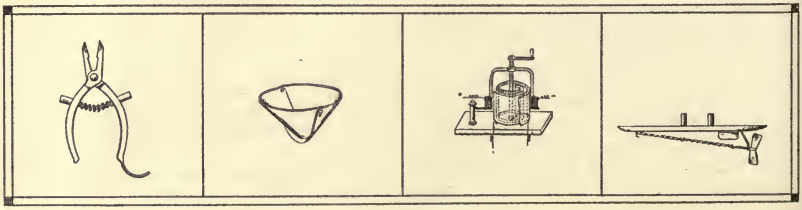
A very clever form of drinking cup has recently been patented by a West Virginian inventor. As shown in the illustration, this cup consists simply of two sections held together by metal eyelets in such a manner that normally the cup is absolutely flat. When it is desired for use, one section is turned around so as to form a cone-like container.

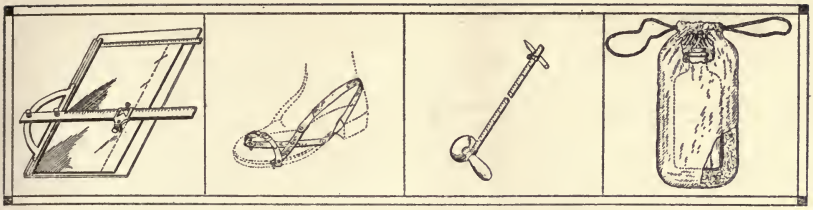
A Clever Electrical Instrument

To an Austrian inventor an American patent has been granted for an electrical measuring device shown in one of the illustrations. This device is termed an Electric Capacitative-Inductive Coupling. While the exact use to which this instrument can be put is not made clear in the patent papers, the commendable feature of the device is the mechanical construction. It will be noted that as the handle is turned, the coil is lowered and the condenser strips in the center are spread further apart from each other.

A Toy Motor-Boat

A New York inventor has succeeded in obtaining a patent on a rather novel toy in the form of a motor-boat driven by a rubber band motor. As shown in the illustration, the top consists of a light hull with such ornamentation as smokestacks in order to give it a realistic appearance, as well as a rubber band motor under the hull driving a large propeller.





Glass Cutting Tool

To facilitate the cutting of glass in any desired shape an inventor has patented the device shown in one of the accompanying sketches. It consists of a base on one side of which is a metal groove that holds a sliding portion to which is attached a straightedge. As will be noted, the straightedge can be adjusted to any angle by loosening the set screw. The sliding member is made in the shape of a protractor and graduated accordingly. On the straightedge slides a member holding a piece of marking chalk. In use, the straightedge is set at right angles and its sliding member is moved to the desired width. By sliding the straightedge at right angles a chalkline is drawn on the glass.

A Shoe Attachment

Among the many recent patents granted for articles of Winter use is a simple attachment that may be fastened to any shoe by means of a simple strap. The attachment consists of two metal pieces crossing each other with spikes on the undersides in order to permit of sure footing on ice. A back strap is provided for holding the attachment in the rear while a strap with a buckle is fastened around the toe portion of the shoe for holding the front.

Device for Drawing Circles

A simple device for drawing circles is the subject of a patent that has been secured by a Michigan inventor. This device is exceedingly simple, consisting of a center member for holding a swinging arm, the arm portion, a clamp sliding on the arm and holding the writing member, and lastly, the writing member. The arm is graduated and it is only necessary to move the clamp to the desired degree to secure a circle of any radius within limits.

Mailing Bag for Bottles

A New York inventor has recently secured a patent on a novel mailing bag for bottles, which is shown in the illustration. It consists simply of a bag made of waterproof material and which may be closed by drawstrings at the top. A smaller inner bag is also employed and between this and the outer bag is a space filled with suitable material for protecting the glass bottle from breakage. The material will also absorb the contents of the bottle should it be accidentally broken. One feature of the bag to which the inventor calls particular attention is that the bottle stopper is held firmly in position by the upper portion of the bag closing over it.

Device for Pulling On Shoes

A Canadian inventor has just secured patent rights on a device for pulling on shoes. The device consists of stationary and pivoted members so fastened that the latter may be given an upward movement by pulling on a lever. In pulling the movable member upwards, a lower wedge-shaped portion also gives it a sideway movement so as to form a grip with the stationary member.

Paper Box for Mailing Purposes

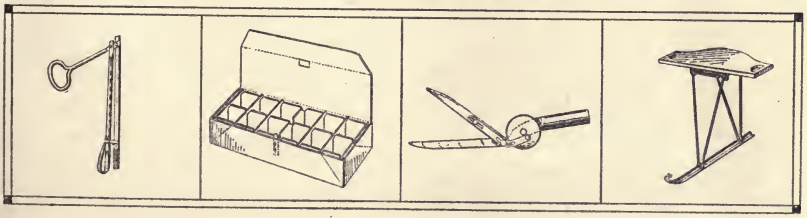
In order to meet the demand for a safe method of shipping eggs by parcel post a patent has been taken out for a paper box by a New York inventor. As will be seen in the sketch, this box is designed much along the same lines as the usual egg boxes fitted with partitions. However, it has a double wall in order to take up shocks. Furthermore, a metal strip fastened to the front of the box, passes through a slot in the lid of the box when the latter is closed and can be bent back to secure it in place during shipment.

Novel Shears

A Michigan inventor has recently patented a design of shears possessing many unique features and advantages over existing types. As will be seen in the illustration, the shears consist of two blades of the usual variety, a wheel member to which one of the blades is connected, and a handle. As the shears are pushed along on a surface, the upper blade is given a cutting movement through the rotation of the wheel to which it is connected. Adjustments are provided for regulating the length of the cut. Obviously, such shears make it a simple matter to cut through fabrics of all kinds.

A Coaster Sled

A sled of entirely new design is the subject of a patent granted to a Pennsylvania inventor. The sled consists simply of a board in which two holes for gripping with the hands are provided, a single runner and the necessary framework. Inasmuch as the sleigh has but one runner, its operation requires considerable skill, while on the other hand, it will probably develop greater speed and provide more enjoyment than the usual type. The rider sits on the board firmly holding each side and balancing himself while coasting down the hill. One novel feature is that the framework can be folded up and the sled carried without difficulty.



Book Reviews

Reference Book on Modern Motor Cars

Under the title of "The Modern Motor Car" there has been published a most excellent work of reference on the modern automobile and everything pertaining to automobile engineering.

Even a casual glance through the many pages of this work* does not fail to reveal that the subject is covered in a thorough and understandable manner. Another feature that is immediately noticed is that the various phases in automobile engineering are considered in proper sequence—a point in favor of the book if it is to be employed as self-instructor on the subject. Briefly, the work covers its field in five parts, as follows: The gasoline engine, carburetors and carburetion, oiling systems and lubricants, cooling, and ignition.

"The Modern Motor Car" is profusely illustrated with comprehensible diagrams clearly showing the construction and operation of every important part of an automobile. The text is clear, to the point, complete, yet devoid of any unnecessary description.

This book will be found a very valuable reference for anyone having to do with a motor car, whether he be a repairman, owner, driver, student or salesman.

* *The Modern Motor Car*, by H. P. Manly. Published by Laird & Lee, Inc., Chicago, Ill. Contains over 512 pages and 217 illustrations. Bound in full leather, flexible covers. Price, $2.50.

Handbook for Electrical Engineers and Students

Although there are many excellent reference books for engineers that are compiled in a condensed, handy form, it is doubtful if there can ever be a superfluity of such works—especially good ones.

Another splendid reference work for engineers and students has recently been published under the title of "American Handbook for Electrical Engineers."* There is scarcely a single subject on electrical engineering or any topic akin to the electrical field that has not been covered in this work. Of course, everything has been condensed, yet the very essence of each subject is given. The work contains many excellent tables and formulas that will be found a great aid to anyone engaged in electrical engineering.

It would be impossible in a review of this kind to enumerate the subjects covered. Suffice it to state that there are over 2,000 pages in this work and in each description of a subject not an unnecessary word is employed. This will give one an idea as to the immense scope of the book. One important feature of the book is that all subjects are arranged alphabetically, beginning at the front and arranged in regular order to the last page. This greatly simplifies the matter of referring rapidly to any desired subject.

We do not hesitate in recommending this work to engineers and students in electricity. It comprises a splendid reference library in itself and will be found a constant aid.

* *American Handbook for Electrical Engineers*, compiled by a staff of specialists headed by Harold Pender, Editor-in-Chief. Published by John Wiley & Sons, New York. Contains over 2,023 pages. Profusely illustrated. Bound in leather, flexible covers. Gilt edge pages. Price, $5.00.

A Reference Work for the Experimenter.

Mr. Edelman has added another contribution to his already numerous works devoted to the experimenters and wireless amateurs of America. His latest work is entitled "Experiments"* and deals with the hobby and profession of experimenting.

The work is divided into two main parts. The first part is devoted to numerous experiments that may be performed by anyone. Most of the information has been secured from the leading scientific magazines; the experiments being culled from these various sources with commendable judgment. Not all of the experiments have been the suggestions of other writers, for there are many by the author of the work, prominent among which are those comprising the series on simple experiments in chemistry which appeared in *Modern Electrics* several years ago. The second part—in reality an entirely separate work—is devoted to teaching an experimenter how to conduct his work systematically so as to obtain the greatest benefits from his labors. Inasmuch as this portion of the book is said by the author to be a compilation of many methods and suggestions of the leading experimenters of today, it is quite unique and invaluable to anyone engaged in research work.

"Experiments" covers a field that is yet comparatively barren of reference works. It is a forerunner of many other books that will sooner or later be published to aid those who devote their time to developing new devices or processes, or discovering new principles, of importance to mankind.

* *Experiments*, by Philip E. Edelman. Published by Philip E. Edelman, Minneapolis, Minn. Contains 256 pages and is profusely illustrated. Cloth bound. Price, $1.50.

Interesting information on telephone receivers for wireless purposes as well as a code chart and time signal facts is contained in the catalogue of C. Brandes, Inc., 1 Liberty Street, New York. A copy will be mailed on request to anyone sending a two-cent stamp.

Questions and Answers

This department will appear regularly in MODERN MECHANICS, subject to the following regulations: The questions must be legibly written with typewriter or in ink, on one side of the sheet. Each question must be definite and cover but one point of the subject under consideration, although a letter can contain more than one question. On the 10th of the second month preceding the date of issue of the magazine, all the questions on hand will be considered and those which are put in the most intelligent manner and of widest general interest will be selected for publication in such issue, the number being governed by the space available. All other questions will be returned to the writers with a statement of the price for which they will be answered by letter. Return postage must be enclosed with each letter containing questions, and the letters must be addressed to the Questions and Answers Department and contain nothing relative to other departments of the magazine.

PREVENTING BELL TROUBLE.

(1) W. H., Brooklyn, N. Y., asks:

Q. 1.—Can the sparking at contacts of electromechanical gongs be reduced? The coils have 40 ohms resistance and the batteries give 15 volts. Eight bells are operated in parallel.

A. 1.—The use of high resistance shunts, as you suggest, will be advantageous, but to predetermine just what number of ohms to use would be only a matter of experiment. There would be the disadvantage, however, from the use of such resistances in that there would always be a leak of current through them. Your best plan will be to use condensers, and a large variety of sizes are now available at very low prices. Address the Western Electric or the Automatic Electric Company, of Chicago.

CHARGING STORAGE BATTERIES.

(2) L. L. F., Cornish, Me., asks:

Q. 1.—Can a 6-volt, 60-ampere-hour storage battery be charged by means of a 14-volt, 3-ampere direct current magneto generator?

A. 1.—Yes, and 3 amperes is a good rate for such a size of battery. Be sure you have a voltmeter of the permanent-magnet type when testing for polarity, else you are likely to reverse the charge, with consequent great injury to the plates. Of course, you also require an ammeter, and the current can readily be adjusted by use of an iron or German silver wire inserted in series with the cell.

Q. 2.—Is the current obtained from a mercury arc rectifier or any form of electrolytic rectifier pulsating or quite uniform?

A. 2.—It is pulsating, therefore it is not altogether adapted for operating such electromagnetic devices as have solid iron cores, nor for exciting the field of an alternator.

WEATHER BULLETINS.

(3) A. A., Pittsburgh, Penna., asks:

Q. 1.—What do the additional letters used by Arlington when sending the weather bulletins stand for? They formerly only sent eight, but now they send seventeen. Also please explain the meaning of the fourth number in each report.

A. 1.—While this matter has been covered before it seems worth while to repeat it because there seems to be considerable misunderstanding as to the meaning of these reports. At eight o'clock every evening the weather is observed and reported by telegraph to Arlington, where the combined bulletin is sent out broadcast at ten o'clock each night. This bulletin is divided into two parts, one for the Atlantic Coast and one for the Great Lakes. The report for the Great Lakes is only sent during the open season or from April to December. The letters used in these bulletins designate the following places where the weather conditions are observed: S—Sidney, N. S.; T—Nantucket; A—Atlantic City; H—Hatteras; C—Charleston; B—Bermuda; K—Key West; P—Pensacola; these make up the Atlantic Coast and Gulf Division. The Great Lakes Division is: DU—Duluth; M—Marquette; U—S. S. Marie; G—Green Bay; CH—Chicago; L—Alpena; D—Detroit; V—Cleveland; F—Buffalo. These latter stations do not come in the report directly after the Atlantic Coast stations, but after the wind forecast for the Atlantic Division. The numbers following these letters consist of the following information: The first three numbers are the barometer, the first figure of the barometer report is omitted as it is unnecessary. The next or fourth number is the direction of the wind, the compass being divided into eight parts for this purpose. North is 1, Northeast 2, East 3, etc. The fifth or last number is the velocity of the wind in the Beaufort scale.

ELECTROMAGNETS AND ACCUMULATORS.

(4) W. B., Cleveland, O., asks:

Q. 1.—What should be the dimensions and winding for electromagnetic coils suitable for use in energizing permanent magnets, such as are employed on ignition generators, the available circuit being 110 volts, direct current?

A. 1.—For such momentary uses it is com-

mon to allow a current far in excess of what the wire could permanently withstand. For instance, if you use the current for only five minutes at a time you could safely permit two to three times as much current as would be safe for a continuously working dynamo. Of course, you wish the coils to be adapted for any size of magnets that may come to hand, and for this reason you can well have the two spools quite independent, a piece of lamp cord providing for putting them in series. If the largest size of stock you find to be ½" x 1½", you can make the rectangular holes in ⅛" fiber flanges ⅝" x 1¾"; and if the closest distance between poles is 3", you can then make outside dimensions of flanges 2⅞" x 4", except that a good place for attaching binding posts will be furnished by letting one side of one flange of each spool be about an inch wider. The connecting member can be of thin sheet metal, either iron or copper, with a winding space between flanges of 4". You can use No. 18 d.c.c. wire, 80 turns per layer, 18 layers, giving a resistance of the two spools in series of 13 ohms; or you can use No. 20 wire, 100 turns per layer, 22 layers, with a resistance of 30 ohms. About 5 lbs. per spool will be required.

Q. 2.—What are the chemical reactions in a lead storage cell?

A. 2.—On the charge the positive plate becomes oxidized (rusted), while the negative becomes less oxidized and sulphuric acid is formed. During the discharge the positive plate becomes less oxidized, an increase in the amount of lead sulphate taking place, while at the negative plate also the metallic lead becomes more or less sulphated. You will find clear and complete descriptions of this action in Watson's book on storage batteries.

RADIO TRANSFORMER.

(5) J. L. G., Rosser, Manitoba, writes:

Q. 1.—In Chapter 1, Section 9, of "Principles of Electric Wave Telegraphy and Telephony," Fleming states that an induction coil can be used as an alternating current transformer if the break and condenser be removed and the primary terminals be connected to a source of alternating current. I thought that the core of the coil must be of the closed core type before it would work on alternating current.

A. 1.—The statement in Fleming is perfectly correct. There is no need for the core to be closed before the coil will work as an alternating current transformer. The earlier government specifications for their naval radio transformers up to several kilowatts often called for open core transformers. The closed core has a much less reluctance to offer the flux so that closed core transformers can be much more economically constructed for power work, but for wireless work this high reluctance is often an advantage to limit the secondary current when the spark jumps, so that we find many open core transformers used in wireless work, but very seldom in power work.

Q. 2.—I am taking up a course in electrical engineering. What particular branch of that profession would you advise me to follow?

A. 2.—The answer to this question can only be determined by you. You know best what you prefer to do. Do what you think you will be most contented in, then you will have the best success there. There is electric traction, central station work, telephone, and other branches of the profession for you to choose from. The central station industry offers fully as good an opening as the other branches. To get into this work you would probably be required to serve time in some power station as operator or load dispatcher, but the ultimate field is very good.

Q. 3.—What kind of a break will I need with a 12-inch spark coil?

A. 3.—The most practical would probably be an independent hammer interrupter operated by an auxiliary circuit.

AUDION.

(6) J. S. S., Plymouth, Wis., asks:

Q. 1.—Can a step down transformer be used to supply the current for the heating element of an audion detector? The transformer is to be used on 110 volt, 60 cycle alternating current.

A. 1.—No, a transformer cannot be used to supplant a storage or primary battery to supply an audion detector. The audion is dependent in its action on the fact that the current through the heating element is emitting ions in a given direction which enables it to act as a rectifier. If alternating current were used the polarity of the grid would constantly be changing and the audion would no longer act as a rectifier. Having to use a storage battery or some other equally constant supply of direct current greatly limits the application of the audion for amateur use. This is unfortunate, since the audion is a very sensitive device.

PSEUDO AERIAL.

(7) J. D. E., Parisville, Miss., asks:

Q. 1.—I am located about 70 miles from the high power station at New Orleans and would like to put up a receiving set so as to hear them. It is inconvenient to put up an aerial and we have 110 volt A. C. in the house but with no day current. Could I use these electric light wires as an aerial when the current is off?

A. 1.—We doubt if you would have any great success with this type of aerial, although it might possibly work if the line is ungrounded. The mass of iron due to the transformer at the end of the line would probably damp out any received signals so that you could not use these wires for an aerial. Why not try putting up an indoor aerial?

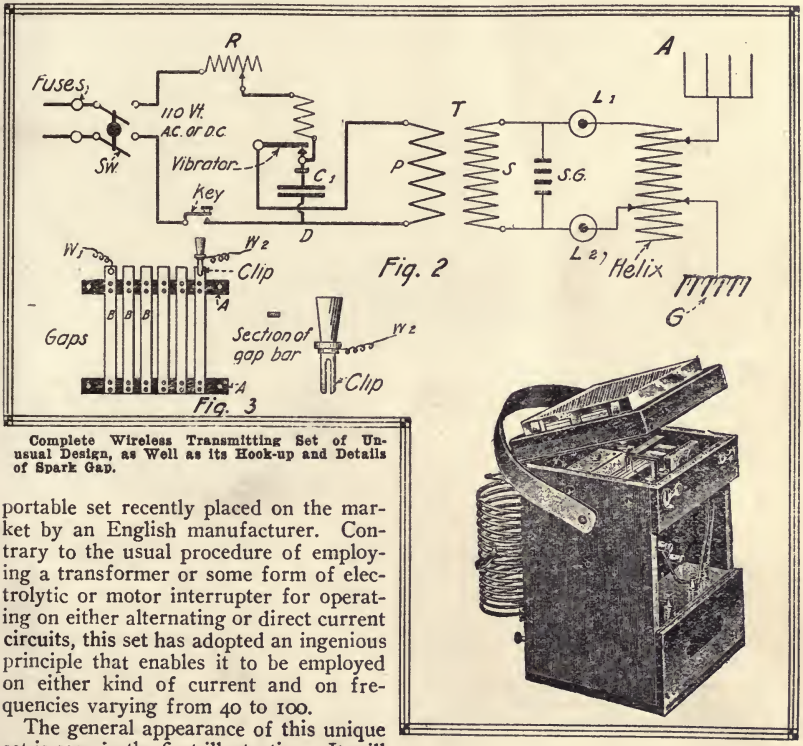
Radio Section

Devoted to the encouragement of the amateur and experimenter in the field of radio communication

TRANSMITTING SET OF RADICAL DESIGN

A NEW and rather radical departure in the design of wireless transmitting equipment is presented in a portable set recently placed on the market by an English manufacturer. Contrary to the usual procedure of employing a transformer or some form of electrolytic or motor interrupter for operating on either alternating or direct current circuits, this set has adopted an ingenious principle that enables it to be employed on either kind of current and on frequencies varying from 40 to 100.

The general appearance of this unique set is seen in the first illustration. It will be immediately noted that the apparatus is exceedingly compact and rugged, permitting of its use to good advantage for army work as well as on aircraft. The set comprises everything necessary for transmitting with the exception of the 110-volt generator. These sets have been made in capacities ranging from ⅛ to 1 K. W.



Complete Wireless Transmitting Set of Unusual Design, as Well as its Hook-up and Details of Spark Gap.

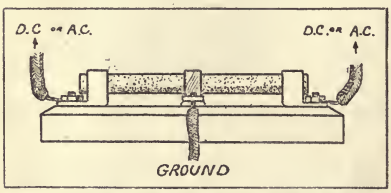
The set includes a step-up transformer of very small proportions, a special magnetic vibrator, leyden jars, tuning helix, vibrator condenser and key. The general arrangement of these parts may be gained from the accompanying wiring diagram. It will be noted that 110 or 220 volt current passes through fuses and a switch to the rheostat and choking inductance *R;* thence through the vibrator magnet winding *M,* on through the vibrator break and around the primary coil *P* of the step-up transformer *T,* back through the key to the source of current. Current flowing through this circuit causes the vibrator to make and break the flow of current in the primary circuit many times a second. Frequencies emitting a tone equivalent to that of a 500-cycle set may be obtained with stiff tension on the vibrator armature. Oscillations are created in the tuned circuit comprising the inductance *P,* condenser C_1 and spark gap *E.* It will be noted that the vibrator gap acts as a spark gap of the oscillatory circuit just outlined. This circuit must be tuned correctly, of course, in respect to the secondary circuit, if best results are to be obtained with the set.

The secondary transformer circuit is connected to two leyden jars L_1 and L_2 and also to a spark gap *SG* and a helix for tuning in the aerial and ground. The spark gap is exceedingly ingenious and of somewhat unusual design, as may be seen from the sketch of the gap. Although this gap is sometimes termed a "quenched" gap by some builders of radio apparatus, in view of the fact that the gap is open it cannot be considered to be of the quenched type, since many gaps of that kind depend for their efficiency upon the feature that the spark discharges occur in a partial vacuum. However, irrespective of the type to which this gap may lay claim, it is a very efficient gap for the purpose. It comprises a number of zinc bars *B* about ⅛ x ⅜″ in section and from 6 to 8″ long. These are mounted on two hard rubber or fibre bars *AA.* A clip fastened to a flexible cord lead permits of any number of gaps being connected in series. The individual gaps are quite short, being about 1/64″. Series gaps of this design are very efficient in producing a sharp condenser discharge, since they cool much faster than would a single, larger gap.

The outfit is so compact and possesses so many features that many amateurs could well adopt the principles presented. Of course, no definite dimensions can be given and much experimenting must be resorted to in order to find the best proportions for the various parts. The condenser C_1 is perhaps the most difficult part to construct inasmuch as it must be made of tinfoil and mica, the latter being about eight to ten mils thick. The vibrator should be fitted with very heavy silver contacts about ¼″ diameter or more.—H. Winfield Secor.

PROTECTIVE DEVICES

One of the best and most widely used devices for protecting generators and motors operating a wireless circuit is shown in the accompanying drawing. A high resistance carbon rod is mounted in such a way as to allow the two ends to be shunted across the D. C. or A. C. low tension lines, while the middle of the carbon rod can be connected directly to earth. By this means the induced currents due to electrostatic induction are led directly to earth without injuring the low potential circuits. The carbon rods offering a very high resistance to low tension currents only allow the high tension induced currents to pass and they



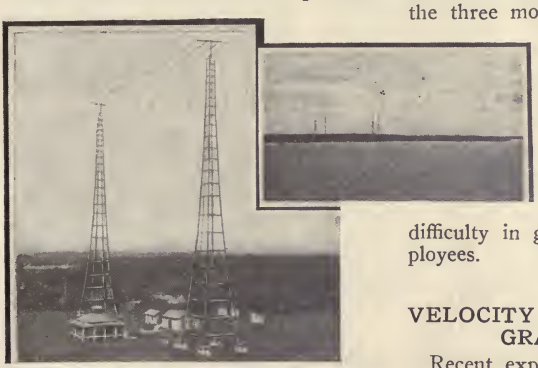
Graphite Rod and Connections for Protecting Power Lines.

thus find their way directly to earth, while the low tension currents are not affected.

This device is necessary in all cases where a motor is directly connected to a rotary spark gap. On transmitters using from 2 K. W. upwards, these protective devices are indispensable and should be shunted across the primary of the transformer, the A. C. and D. C. terminals, and across the motor and generator fields.—Geo. S. Smythe.

WIRELESS STATION ON CARIBBEAN SEA ISLAND

SOME 250 miles north of Colon in the Caribbean Sea lies a strip of land two miles long by one wide known as Swan Island, upon which has recently been completed a wireless station requiring two 250 horsepower engines when in operation. The station is owned by the United Steamship Company and has in constant attendance two operators.



Close and Distant Views of the Wireless Station at Swan Island, in the Caribbean Sea.

These, with from fifteen to twenty white men and as many Jamaica negroes, constitute the sole population of the island, which produces from 15,000 to 25,000 cocoanuts monthly.

The soil is excellent, producing all kinds of tropical fruits and vegetables. Duck, teal pigeons and turtle abound. They have a water distilling apparatus capable of providing for 100 men and large tanks for collecting rain water. It is difficult to keep men on this isolated island. Steamships anchor out ½ or ¾ of a mile from the shore about once a month and lighter needed supplies and mail to the men.

Laborers leaving New Orleans or other ports must sign a contract to remain at least three months. Their transportation is furnished and all expenses on the island paid. If they leave before the three months expire they forfeit their wages, getting nothing for any work they may have done. Sometimes they stay longer; a few have remained two or three years. No women are allowed on the island. That may, in a measure, account for the difficulty in getting and keeping employees.

VELOCITY OF WIRELESS TELEGRAPH SIGNALS

Recent experiments of French scientists to determine the velocity of wireless telegraph signals indicate that this velocity is slightly lower than that of light. The method adopted is to send out a signal from the Eiffel Tower to another station whose distance has been very accurately calculated. At the moment the signal reaches the second station a return signal is automatically sent back. The time of emission and reception is recorded by means of a photographic micro-galvanometer in which the record is made on a moving band of sensitive paper. Thus the time elapsing between two successive records will measure very

accurately the time taken by the signal to travel the double distance. As the result of these experiments the following figures have been arrived at:

Paris to Toulon, .00237 sec.; Paris to Washington, .02122 sec., with a possible error of .00001 sec.

This indicates that the average velocity of the wireless signal is about 296,000 kilometers (185,000 miles) per second; that of light being about 186,000 miles per second.

RADIO LAW OFFENDER IS PUNISHED

An amateur radio operator residing in the Bronx section of New York City has recently pleaded guilty before Judge Foster in the United States District Court in New York City to the charge of operating a wireless station without the necessary government license, using a wave length in excess of 200 metres which interfered with commercial stations, as well as using unofficial radio call letters. He was fined by the Court and cautioned not to repeat the offense.

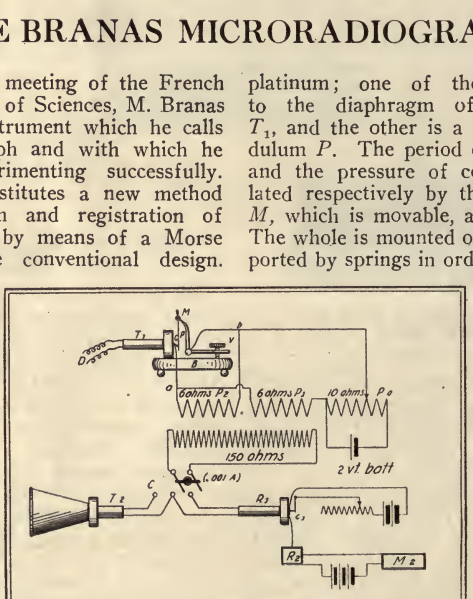
This is the second case of its kind reported to the District Attorney by W. D. Terrill, Radio Inspector in charge, for a violation of the radio laws. The former case was that of another New York amateur who was fined by the Court the sum of $50 for operating a radio telephone without a license.

These two instances should act as a caution to all amateur wireless operators. Anyone violating the radio laws is more than certain to be discovered and brought to Court sooner or later.

THE BRANAS MICRORADIOGRAPH

At a recent meeting of the French Academy of Sciences, M. Branas described an instrument which he calls a microradiograph and with which he has been experimenting successfully. This device constitutes a new method for the reception and registration of radio telegrams by means of a Morse recorder of the conventional design.

The instrument consists of two parts: the amplifier and the relays. The amplifier includes a variable resistance contact, an open magnetic circuit transformer and a potentiometer. The variable resistance *c* is placed between two pieces of platinum; one of these is attached to the diaphragm of the telephone T_1, and the other is a part of the pendulum *P*. The period of the pendulum and the pressure of contact are regulated respectively by the counterweight *M*, which is movable, and the screw *V*. The whole is mounted on a block *B*, supported by springs in order to deaden any vibration, and which may be enclosed in a glass case to protect it from sound waves.



Wiring Diagram of New Wireless Recording Apparatus.

The primary winding of the transformer is divided into two equal parts P_1 and P_2. The part P_1 is mounted in derivation

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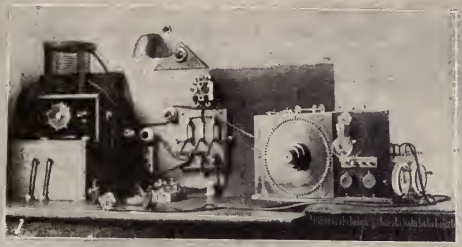
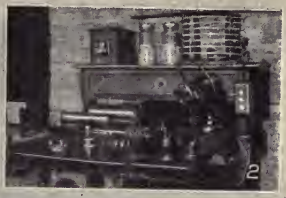
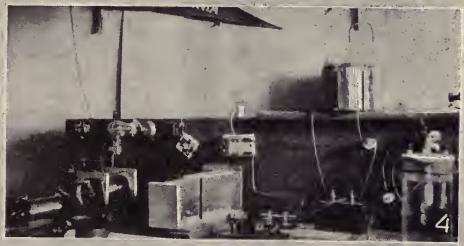
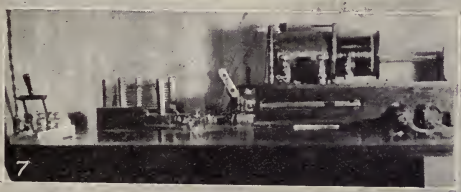
AMATEUR WIRELESS STATIONS









THE STATIONS AND APPARATUS IN THE ABOVE VIEWS ARE AS FOLLOWS:

(1) Wireless transmitting and receiving outfit of Louis W. Elias of Columbus, O. Most of the apparatus has been made by the owner of the station. (2) Wireless station of Royal Weith, Chicago, Ill. (3) Wireless station of Charles Reynolds of Binghamton, N. Y. Three receiving sets are employed in this station, any one of which may be used for reading time signals from Arlington, Va. (4) Wireless station of H. Woods, Glendale, Cal. (5) Wireless station of W. Buckner, Paris, France. (6) Wireless station of Frank Pierce, Lincoln, Nebr. A 1 KW. transmitting set is employed. (7) Receiving and sending apparatus of T. C. Thompson, Montreal, Canada.

upon the contact c, in such a way that the current leaves the potentiometer P_0, continues across the half of the primary P_1 to the point a, where it divides to pass partly by the winding P_2 and partly by the contact c; thus reaching the point b and from there to the potentiometer. The direction of the current therefore changes from one-half of the primary to the other. The commutator C permits the sending of the current from the secondary winding either to the loud speaking telephone T_2 or to the relay R_1. The latter consists of a contact c' similar to the contact c, and is mounted in derivation with an ordinary relay R_2 which is necessarily in short circuit while the contact c' is not broken. At the moment that this contact is interrupted, the relay R_2 works and causes the operation of the Morse apparatus M_2.

WIRELESS TIME SAVERS

By P. H. Markmann

HOW many operators have tried to "raise" a station and, on account of the sharp wave of their transmitter as well as the great selectivity of the instruments at the receiving end, have been unable to make themselves heard?

The above troublesome factors, namely, sharp waves and close tuning, are absolutely necessary; the first is due to the law and the latter to the large number of sets in operation.

The author was troubled in this manner until he came across a method that permits of obtaining a broad wave without changing the transmitting adjustments or employing excessive wiring. It is simplicity itself and consists of a small rheostat regulator in the aerial circuit. The damping in the circuit depends on the resistance as one of the factors, with the result that an increase in the resistance augments the damping of the aerial thus creating a broad wave. In this manner, if an operator desires to call a station, he inserts a little resistance in the aerial and proceeds to call the station desired. The operator at the receiving end does not have to have his instruments closely tuned to the transmitting wave length in order to hear it. Of course, as soon as the station has heard the call and is tuned to receive the message, the resistance is cut out. If the rheostat regulator or other suitable form of variable resistance is inserted in the circuit above the aerial switch, the same procedure can be employed for receiving. By adding resistance it will be found that messages may be received over a wide range of wave lengths.

The aerial switch is usually a bore and it will be found advisable to adopt a good break-in system. There has been any number of these systems described in the columns of past issues of this magazine and its affiliated publications. As a word of suggestion, however, a system should be selected that has no spark gap in the ground lead since it will be found preferable.

Another source of considerable bother is the rotary spark gap, for it continues to run long after the current has been shut off, seriously interfering with the receiving operations. If it is connected to the aerial switch it requires considerable time to attain its speed, while on the other hand, if a separate switch is used to control it, that much extra work is involved.

There are two ways for doing away with the foregoing disadvantages. In the first place, it is possible to employ a gap similar to that of the old Marconi discharger. It consists of two contacts on the motor shaft revolving between a set of stationary plugs arranged in a circle. One-half of these are connected

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AMATEUR WIRELESS STATIONS

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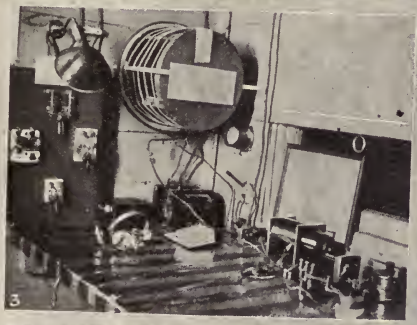

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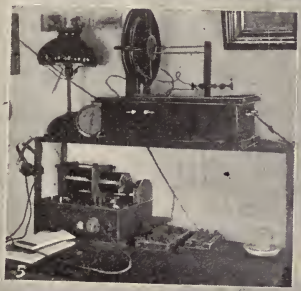

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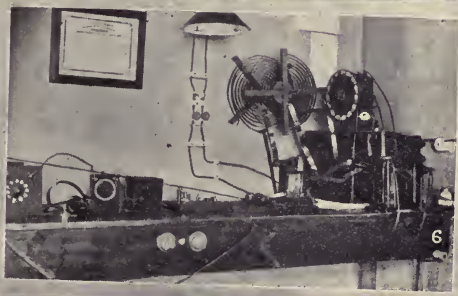

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THE STATIONS AND APPARATUS IN THE ABOVE VIEWS ARE AS FOLLOWS:

(1) Wireless station of Roy Waller, Cambridge, O. (2) Wireless station of Alfred Meuler of Oconomowoc, Wis. Practically all of the apparatus in this station has been home-made. (3) Receiving and sending apparatus of Carl Kottler, Milwaukee, Wis. The sending set consists of a one-inch coil operated from a step-down transformer. (4) Wireless station of W. E. Merrill of New York City, N. Y. The owner of this station has been aiming at efficiency and compactness in building his apparatus. (5) Wireless station of Ercil Armold, Chapman, Kans. (6) Wireless station of Edward L. Norton, Rockland, Me.

to one side of the current while the other half are connected to the other side. This gap starts quickly and, since it carries but little weight, it likewise stops quite suddenly. Another method is to employ a quenched gap. Of course, the usual chorus to this assertion is "It can't be done. I have 60 cycle current." But it *can* be done. It will give a mushy sounding spark, to be sure, but the efficiency is very high. And efficiency should not be confounded with the tone of the spark. It merely remains for the receiving station to have a tikker and great results can be obtained with a quenched gap.

A tikker is something which every station should have among its collection of detectors. It can be readily made, merely consisting of a toy motor, a grooved brass disc and a piece of springy brass wire. The disc is placed on the motor shaft and the wire is arranged to press lightly against the groove. The motor is driven at full speed. The wire and the disc are connected in series with the telephone receivers; the latter being shunted across a variable condenser employing air for the dielectric. However, the condenser need not be gradually variable, and one with five different capacities, which will be found ample, can be made as follows:

Twelve sheets of aluminum four by six inches are obtained. These should be perfectly flat and laid one above the other in a box of suitable size to hold them. The sheets are separated by strips of thin mica laid around the edges. Six of the sheets are connected to one post and the balance are connected to three contacts as follows: One sheet to the left-hand point, three to the center point and two sheets to the righ-hand point. The switch lever should be wide enough to bridge two contacts. A little thought will readily demonstrate how five variations of the capacity may be obtained by using the contacts singly or in pairs.

SILVER PLATING WIRELESS INSTRUMENT PARTS

Silver plating is particularly suitable for the metal parts of wireless instruments, as brass or copper left in its natural state will tarnish, spoiling the appearance and reducing the efficiency of the instrument. Even if these parts be nickel plated, nickel is a comparatively poor conductor and whatever is gained in appearance is lost in efficiency because the high frequency currents used in wireless travel apparently only on the surface—the plating—of the metal. The difference is so small as to be negligible, but when the infinitesimally small amount of current coming into a receiving instrument from a distant station is considered, it can be readily seen that any tarnished or dirty contacts, or any metal of low conductivity in the circuit, is liable to affect the working of the instrument and should be carefully guarded against. Silver, being a slightly better conductor than copper, should be used wherever possible in the instrument circuits.

A NEW TIME SIGNAL SERVICE

The Illinois Watch Company, of Springfield, Ill., announces the installation of a new transmitter of much higher power than hitherto used and invites all amateurs who pick up their time signals at 11.55 to 12.00 and 7.55 to 8.00 Central Time, to notify it of the fact by postcard. The signals should be audible from Denver to the Atlantic.

It is reported that Peter Cooper-Hewitt, of mercury-arc fame, is working upon radio apparatus of new and interesting design, in which the use of the mercury-arc bulb is indicated. While the time is not yet ripe for a public announcement, still it is hoped that further details may be available for publication in the February number.

How Wireless Stations are Tuned

By Geo. S. Smythe

To many readers the tuning of a transmitting set is still a mystery. In the contribution that follows the methods of tuning employed by Government inspectors and commercial companies are explained at length.

TO tune a transmitting circuit containing an oscillation transformer, three readings are required: the wave length of the open circuit, the wave length of the closed circuit, and the wave length of the complete set coupled in the ordinary manner.

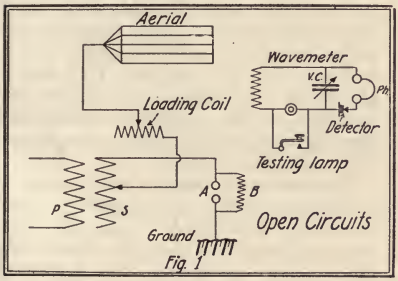


Fig. 1

The wave length of the open circuit is obtained by entirely disconnecting the oscillatory circuit from the primary of the oscillation transformer as in Fig. 1. A small spark gap *A* is placed in series with the antennæ and is energized by a small induction coil *B*. When the induction coil is placed in operation high frequency oscillations are set up in the open circuit, the period of which can be determined by varying the capacity *c* of the wavemeter until the loudest sound is produced in the head 'phones. The wavemeter being now in resonance with the open circuit, the natural wave length can be found by referring the reading of the capacity on the wavemeter to the graph or table on the lid of the meter.* To tune to a definite wave length the inductance in the secondary of the oscillation transformer should be varied until the wavemeter registers the wave length required. It is generally found that the number of turns in the secondary is not sufficient to step up the wave length. In this case a loading coil is necessary.

The closed circuit should then be tuned with the earth and aerial connections removed from the helix. The primary of the oscillation transformer and spark gap should be energized in the regular manner. Instead of using the detector on the wavemeter as in the last experiment, the small lamp should be

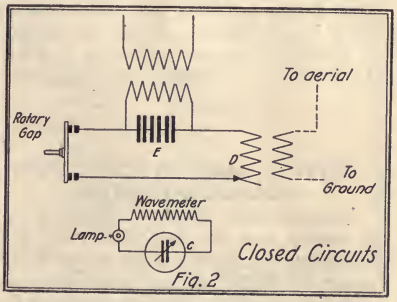


Fig. 2

* The author is referring to the Marconi wavemeter. However, other wavemeters may be used in a similar manner.

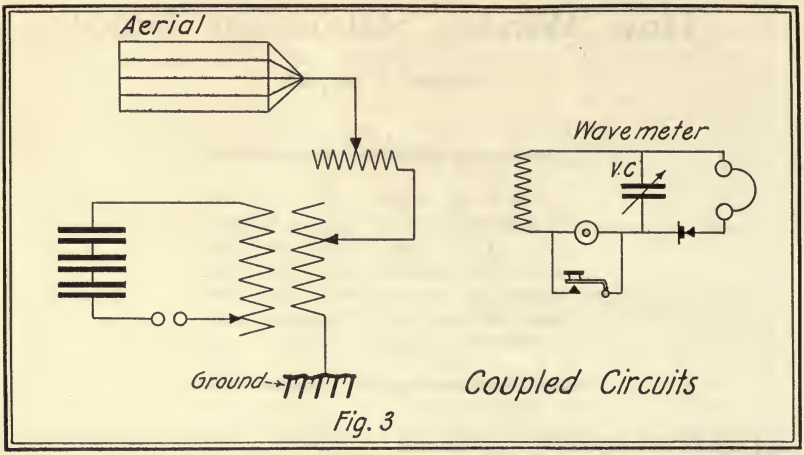


Fig. 3

used. The point of resonance between the wavemeter and the closed circuit will be indicated by the maximum glow of the lamp, but care should be taken not to bring the meter too near the closed circuit when the key is pressed, inasmuch as the induced oscillations may be so strong as to burn out the light or puncture the insulation of the inductance coil. The circuit can then be tuned to the required wave length by adjusting the inductance *D* or capacity *E* of the closed circuit. The arrangement can be seen in Fig. 2.

After the two circuits have been independently adjusted to the required wave length, the set should be coupled in the regular manner as in Fig. 3. When the circuit is energized the wavemeter will show two points of intensity, thus giving two separate wave lengths. This is due to the magnetic fields of the open and closed circuits acting upon one another and causing the antennæ to have two periods of vibration. This can be effectually minimized by reducing the coupling of the oscillation transformer until the wavemeter shows as far as possible a single radiation.

The degree of coupling can be figured as follows: Suppose the reading on the wavemeter indicates that two waves are being radiated, one being 630 meters, the other being 570 meters, the degree of coupling would be,

$$\frac{630^2 - 570^2}{630^2 - 570} = 9.9 \text{ per cent.}$$

NOVEL INSULATORS FOR SMALL AERIALS

Large wooden spools on which thread is wound may be easily converted into insulators for small aerials where a low power is employed for transmitting, or in cases where an aerial is employed for receiving only.

The spools are first baked by leaving them in an oven for a few hours in order to eliminate all moisture. They are then soaked in melted paraffine, followed by another baking, and finally shellacked.

Spools treated in this manner make attractive and very efficient insulators. They may be employed in the same way as common porcelain knobs. To provide better insulation two or more should be employed in series.—JOHN B. RAKOSKI.

The next cover of this magazine will appear as MODERN MECHANICS.

AN IMPROVED BUZZER TRANSMITTER

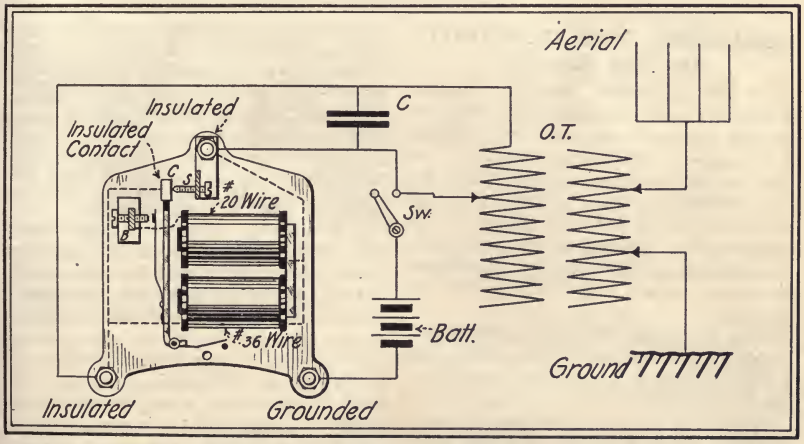
WHEN it became necessary for the writer to employ an oscillation transformer in connection with a buzzer transmitter because of the wireless law, it was found that the distance covered was greatly reduced. Not wishing to employ a larger set for local work, it was decided to change the windings on the magnets of the buzzer and put on another contact or "gap." With these alterations the writer can now cover a greater distance with an oscillation transformer than was possible with the old method.

In order to make an efficient buzzer transmitter that will operate in connection with an oscillation transformer, remove the two magnets from the buzzer and take off the windings. The iron cores are then covered with Empire tape. One of them is wound with No. 20 wire, while the other is wound with No. 36. The former is placed nearer the free end of the armature as the speed of vibration can be better regulated. The inside ends of the wire on the two magnets are then connected together and to a binding post set in the upper screw-hole yet insulated from the frame. The screw is also used to hold a small lug *L* which is threaded for the screw *S*.

The other end of the No. 20 wire is attached to the adjusting screw bracket *B* as in the regular buzzer connections. The other end of the No. 36 wire is fastened to the insulated binding post of the buzzer and to the insulated contact on the armature. The contact piece *C* is so placed that it forms a small gap with screw *S*, the latter regulating the length of the gap.

This arrangement makes the buzzer a small closed core transformer, but since such an instrument will not work directly on battery current, the vibrator must be employed. A small condenser is placed around the primary contact to reduce the sparking as well as increase the efficiency of the buzzer. If the buzzer is employed in connection with a step-down transformer instead of batteries, the primary contact may be done away with and the ends of the No. 20 wire connected with a key in series, direct to the low side of the transformer.

The gap is synchronous and the set should emit only one wave length.—FRANK H. BROOME.



Hook-up for Buzzer Transmitting Set of Original Design. Such a Transmitter Will Emit Waves in Keeping with the Wireless Law Restrictions.

AN INEXPENSIVE ROOF INSULATOR

An inexpensive roof insulator may be made from ordinary material as follows:

Take three thick porcelain plates, one of which should preferably be a soup plate, and drill or otherwise make a ¼-inch hole through the center of each. A convenient method of accomplishing this is to use a flat ended iron rod ¼-inch thick, fitted into an ordinary hand drill, using plenty of emery and oil while drilling. The plates are assembled in the manner shown in the sketch, being bolted on a threaded brass rod 12 inches long. To make the insulator water-tight, a rubber washer should be used between the roof and the second plate. The remaining plate is then tightly bolted to the brass rod on the inside of the roof. As this bolt holds the entire structure in place, it should be turned tight, although care must be employed not to place too much strain on the plates. Both ends of the lead-in rod are then fitted with thumb screws and the connections made as usual.

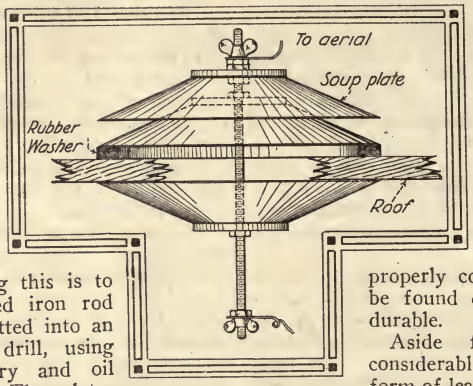


Diagram of Inexpensive Roof Insulator.

Although the arrangement at first appears to be a fragile one; if properly constructed it will be found quite strong and durable.

Aside from possessing considerable strength, this form of lead-in insulator has excellent electrical qualities. Owing to its unique design it is almost impossible for the transmitting power to leak off to the ground, even when the insulator is wet from rain, and it is obviously impossible for rain to leak in through the hole in the roof.—CHAS. BERNTSWILLER.

REGARDING THE SENSITIVITY OF THE AUDION

In the December issue of *Popular Electricity and Modern Mechanics* an article appeared on page 700 entitled "At Last—A Permanent Detector." In this article a statement regarding the new detector reads as follows: "As for the sensitivity and tone of signals of the detector, it is claimed to be more sensitive than the audion which is considered the most sensitive detector in use today."

The De Forest Radio Telephone and Telegraph Company of New York, has taken exception to this statement, writing as follows:

"Two of the inventors of this detector were present at a test which was conducted in the laboratory of this company, at which tests it was conclusively shown that their detector was less sensitive than the S grade or Standard Audion bulb and was not equal in sensitive quality even to the best mineral detectors. It compared favorably with the silicon detector which is far less sensitive than the audion. Tests of the U. S. Bureau of Standards show that the S grade Audion is at least 50 per cent. more sensitive than the best mineral detectors and for results of these tests we refer you to the Bulletin of the Bureau of Standards (Vol. 6, No. 4, page 540)."

The writer of the article appearing in the December issue had no facilities for testing the sensitivity of the new detector. Nor did he cite any of the advantageous features and comparative sensitivity of the new detector on his own authority. The statements were not claims of the writer or this publication, but were made purely from a reportorial standpoint. Furthermore, this magazine declines to enter into controversies which are properly between manufacturers.

CONSTRUCTION OF AN OIL INSULATED CONDENSER

Knowing that many amateurs have never attempted the construction of an oil condenser merely for fear that it is too difficult to build, I have endeavored in the following article to describe the essential points in the construction of an oil insulated condenser, which no amateur should hesitate to construct.

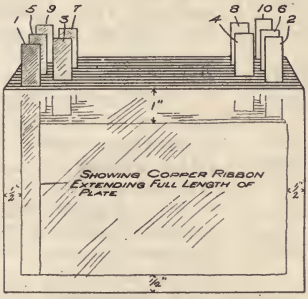


Fig. 1.—View of Glass Condenser Plates Assembled.

To save expense, old photographic plates may be used for the dielectric. They can be obtained for little or no cost from a photographer or photo-engraver. If plates are used, every trace of emulsion must be cleaned from them by several baths in hot lye water. When clean, the plates should be bright and shiny with no spots on them. They may be of any size, from 6½ by 8½ inches up. If lugs are of proper dimensions to reduce connection resistance to a minimum, the smaller the plates are the better. Plates 6½ by 8½ inches are large enough for transformers up to about five kilowatts, but a great number of plates are necessary and if the voltage is too high the plates must be connected in series—parallel, to prevent puncturing.

The tinfoil should be fairly heavy. One piece is fastened to one side of each glass plate by means of the oil in which the condenser is afterwards to be immersed. This is done by putting a little oil on the tinfoil and after it is laid on the plate, squeezing all the oil possible out from between the tinfoil and the glass. A ½ inch margin should be left on three sides of the tinfoil and on the fourth side, one of the long edges of the plate where the lugs are to be taken out, the margin should be 1 inch. In oil this margin will suffice for condensers subjected to a pressure up to 30,000 volts.

The lugs should be made of copper ribbon at least ½ inch wide. These are laid on the tinfoil in the proper position before the next plate is placed. The pressure of the plates when bound together before immersion in oil will make good contact between the copper lugs and the tinfoil sheet. In this condenser each alternate sheet, beginning with the first, is connected to one terminal and each alternate sheet, beginning with the second, is connected to the other terminal. In order to prevent sparking to the lugs, the lugs coming from alternate plates are staggered, as shown in Fig. 1.

The containing tank for the oil and condenser plates is made of heavy gauge galvanized iron. It is strongest when made in one piece, as in Fig. 2, the lap seams being well soldered together. The dimensions of the tank should suit the size of plates used, but the tank must be large enough to permit good insulation between the edges of the plates and the bottom and sides of the containing tank. It must also

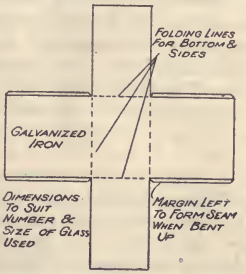


Fig. 2.—Pattern for Condenser Tank.

be deep enough to permit covering the plates with oil.

The lugs, as before stated, come out on one of the long sides of the plates so that the distance between the two sets of lugs is the greatest possible. Tape about ten of the plates together and put them in the oil tank with the lugs all coming out on top.

The connection of the alternate plates to the two common terminals is accomplished by means of two heavy busses of copper or brass rod. They are fastened to the containing tank by hard rubber in positions parallel to each other and running almost directly over their respective lugs. One way of connecting the lugs to the busses is by soldering stranded wire to each lug and running each wire or two to a hole drilled in the buss rod, a set screw being used to hold the stranded wire in place. This method allows any number of plates to be cut in or out. The details of this construction are shown in Fig. 3.

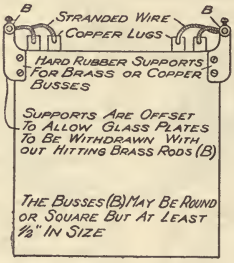


Fig. 3.—Method of Making Connections with Lugs.

To finish the apparatus, it may be placed in a mahogany or oak case. Even if not put in a case, some form of a top must be made to keep out all dust and dirt. It is well to remember in finishing the apparatus, that none of the conducting metal should come in contact with anything but the hard rubber supports that are necessary to hold it in place, otherwise an undue amount of current will leak away.

A good grade of transparent oil-switch or transformer oil should be used in the condenser.

Of course, the dimensions may be varied should the builder desire a smaller or larger condenser, the various parts being kept in about the same proportions. The condenser will be found very satisfactory.—PAUL R. FENNER.

A SUBSTITUTE FOR A TELEGRAPH SOUNDER

When a flame is brought between the two terminals of an energized circuit, the flame will be deflected towards the negative pole. This interesting phenomenon of a flame can be very successfully utilized in place of a sounder for telegraph work.

Play a candle flame, or some other source of flame, between two conductors placed in circuit with a telegraph key and a battery current of not less than ten volts. When the circuit is closed by the key, the flame will immediately assume a flattened shape, but resumes its normal shape immediately after the key is released. This property of a flame, it will readily be seen, can be used for receiving telegraph signals in place of a buzzer or sounder, as the deflection of the flame can be easily read in place of the ordinary sounder signals.

This interesting phenomenon can also be utilized in determining the positive or negative poles of a line, as a deposit of carbon will accumulate on the negative pole.—CHAS. BERNTSWILLER.

AUTOMOBILE TOP EMPLOYED AS WIRELESS AERIAL

The correspondent of an English automobile trade journal writes regarding an interesting application of wireless telegraphy on a motor car, in which the top was used as the aerial.

According to the report, it is gathered that an English cavalry patrol recently came across and captured a German touring car in which were two German officers. The engine had broken down and the men were unable to make their escape. One of the patrol chanced to notice a wire leading to a metal member of the automobile top. A careful search revealed a complete receiving outfit.

ARLINGTON TIME SIGNALS FLASHED 4250 MILES

The effectiveness of the time signal service rendered through the Arlington radio station is evinced in a recent report made by Capt. J. A. Hoogewerff, Superintendent of the Naval Observatory at Washington. The time signals flashed at noon every day and at ten o'clock at night have been reported from a point 600 miles south of Rio de Janeiro, at which point the total distance from the Arlington station is 4,250 miles, according to the statement made by Capt. Hoogewerff in his annual report just made public.

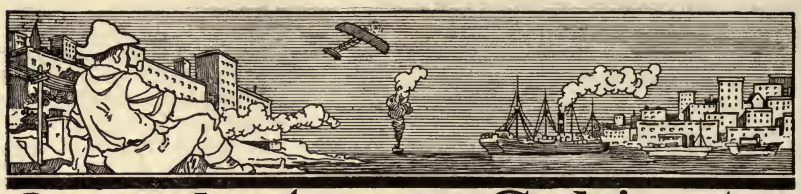
NEW DETECTOR PROVES EFFICIENT

MOST wireless amateurs have been looking forward to the invention of an ideal detector of the crystal type combining extreme sensitivity, neatness—yet small, and above all, easily adjusted and when in that condition, capable of retaining its adjustment for some time. Everyone who has experimented with wireless apparatus is familiar with the patience and skill that are required to adjust the ordinary crystal detectors for securing good results. Furthermore, the aggravation caused in losing the adjustment by an accidental knock or jar, necessitating the readjusting of the detector, is too well known to require further mention.

All that has been sought in the way of a detector is claimed to be realized in the invention of Eugene T. Turney of New York City, of a new detector, namely, the "Crystaloi," derived from two words "crystal" and "alloy," which constitute the elements of the detector. This detector seems to be ideal in all respects, sensitive, small, neat of appearance, easily adjusted, and above all the ability to retain the adjustment. It is claimed by the inventor that it will withstand any ordinary shock or jar, will not burn out or go dead, requires no renewal of parts or the use of batteries, thus eliminating all operating expense.

All that is needed to adjust the detector is a buzzer, found in most every amateur station. By simply rotating the small wheel-like cylinder that houses the elements until the loudest response is heard in the telephones, it is adjusted to its maximum sensitivity and is ready to receive anything within range of the receiving apparatus. The detector appears to be extremely sensitive to frequencies ranging from 240 to 500 cycles, bringing these signals in much louder and clearer than the ordinary detectors. Upon inserting the detector in circuit a sharpness of tuning will at once be noted. It allows one to use more inductance, thereby making the circuits more rigid, conducing to sharp and selective tuning. Another remarkable claim is that static is reduced to a certain extent, allowing one to read signals which otherwise would be unreadable. A brief description of the antennæ and apparatus used to draw the above conclusions would not be amiss.

Antennæ of the umbrella type, four wires 45 feet long; two wires being 10 feet high, the other two being 20 feet high, spaced about 5 feet apart, all connected at highest end—about 30 feet from ground. Receiving apparatus comprises: inductively coupled tuner, Crystaloi detector, fixed condenser, variable condenser and 3200 ohm 'phones. Connected up as modified Telefunken Set. With this set the writer has copied all stations from V.B.A. Port Arthur, Canada, to Miami, Fla., and ships out at sea from three to four days; the Marconi station Miami coming in very clear and distinct, a 5-kw. non-synchronous rotary gap being employed by that station. Messages from the Panama R. R. Co. steamships K.M.A., K.M.X., K.M.S., K.M.H., when three to four days out, come in with remarkable clearness, these ships being equipped with Telefunken 500 cycle sets of the quenched spark type.—H. ESKAY ENDERWOODS.



On Polyphase Subjects

THE present number marks the beginning of a new volume for this magazine. It has perforce gone through a period of evolution in the past six months; the work of the Editors has of necessity been tentative,—a process of feeling out, as it were. And the reason for this will be readily apparent to the thoughtful reader.

Editing has ever been a more or less thankless task; no one or two human beings could possibly contrive to satisfy or even please a family of considerably more than one hundred thousand other human beings; the more especially when this family is divided into three distinct classes, each with its own individual likes and dislikes. Yet this was the physically impossible task set before the Editors of this magazine when it was given birth through the consolidation of *Electrician and Mechanic* of Boston, *Modern Electrics* of New York and *Popular Electricity and the World's Advance* of Chicago. Each of the three magazines had its own particular following and each was a power in its own field. To combine three such publications into one and to make the consolidation thoroughly satisfying to the diversified tastes of the three distinct classes of readers was a well-nigh superhuman task.

From the start the work of editing has been carried out as a scientist might carry out a series of investigations. Experiments have been performed and the results carefully noted; the failures weeded out and the successful ones repeated. As a result of this experimental work, a very definite conclusion has been reached—a definite policy evolved.

MODERN MECHANICS starts its new year with a new and far-reaching name—a name the Editors purpose to make typical of the contents. And a few words will serve to make the reader conversant with the policy that is confidently expected to achieve this result. The aim will be to provide for the wants of perhaps two classes of readers and in such a way as to make this provision a perpetual one. The two types of readers are, first, the layman who knows nothing whatever about electricity, mechanics or science, and, second, the practical handyman, mechanic or electrician who knows his business, but who is at the same time wise enough to know that the other fellow may have something of value to tell him. For the first man there is the bright, newsy, pictorial section with its hundreds of short, interesting articles on the latest achievements in the fields of electricity and mechanics. Herein, he learns what science is doing to lighten human labor and how it can be made to do his own tasks. For the second man, the practical man, there is the entire second half of the magazine, written by practical men, and devoted to the needs of the handy-man-about-house, the mechanic and the practical worker in the electrical field.

The layman will be prone to criticise the practical man's section and the mechanic will say that he is not interested in the popular section; but let each think for a moment and realize that at some time or other he either has been or will be, as the case may be, in the other fellow's shoes. As the layman's knowledge increases, he will wander into the rear portion of the magazine. He has perchance read a description of some device or machine that would prove a boon in the home, office or factory; perhaps the first thing that strikes his eye as he glances through the practical section is a clear and simple set of instructions telling him how to make, with the simple tools to be found in the average home workshop, the very device he has read about in the popular section. Thus, the layman gradually becomes the practical handyman and his interest in the first portion of the magazine gives way to the new one, born of practical knowledge, in the rear section. But,—we must not forget that for every convert to the practical section there is another brand new layman to take his place, and so on, *ad infinitum*.

A Narrow Escape

"Now, Zeke," the parson said, "you know you must live a Christian life. Have you stolen any chickens during the last six months?"

"No sah, no sah," said Zeke fervently. "Ah ain't done stole no chickens."

"Nor turkeys, nor pigs?"

"No sah, no turkeys nor pigs?"

"I am glad to hear it," said the leader, "and I hope you will continue in this way."

Zeke on his way home said to his wife in a cautious undertone: "Golly, I'd suah been er lost niggah ef he'd said 'ducks.' "—*Successful Farming.*

Surprising

A lady, returning home unexpectedly, found her domestic using the drawing-room for the purpose of giving a select party to her friends. "Ann, I am surprised!" she ejaculated.

"So am I, ma'am," replied the unabashed girl. "I thought you wouldn't be back for a fortnight."—*Chicago Ledger.*

A Homely Tale

A new electrical student seeing a large resistance hanging on the wall of a laboratory remarked to his professor: "Does it not look like a harp?" Whereupon the professor replied, "The only tune it will play is "Ohm-sweet-ohm." ("Home, Sweet Home.")—*W. H. Prendergast.*

Auto Ailments

"Brother Jim has the automobile face. Joe has the motor-bike back and sister Sue has the auto-speed craze."

"Any other automobile ailments in your family?"

"Well, papa says he has the automobile pocketbook, and it's badly punctured."—*Minneapolis Journal.*

Well Taught

An English bishop, offering an orange to a little child, remarked sweetly:

"Now, my little man, I shall give you this orange if you tell me where God is."

"My lord," answered the child, son of a clergyman, "I'll give you two oranges if you'll tell me where he is not."—*Boston Journal.*

A Horse Laugh

Motorist (blocked by load of hay)—"I say, there, pull out and let me by."

Farmer—"Oh, I dunno ez I'm in any hurry."

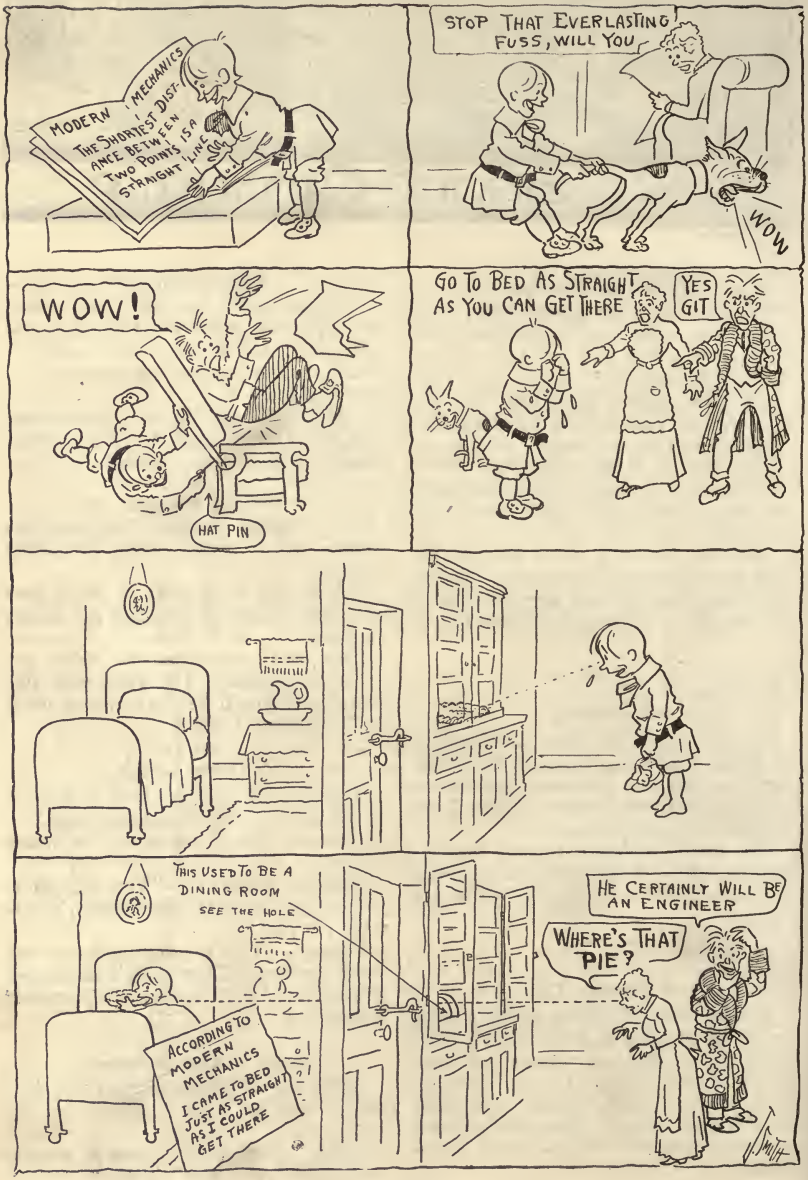
Motorist (angrily)—"You seemed in a hurry to let that other fellow's carriage get past."

Farmer—"That's 'cause his horse wuz eatin' my hay. There hain't no danger o' yew eatin' it, I reckon."—*Springfield Republican.*

Knew of One Advocate

Gabbleton—"Edison declares that four hours' sleep per night is enough for any man."

Kidder—"By Jove! That is exactly what my baby thinks!"—*Judge.*


MODERN MECHANICS
THE SHORTEST DISTANCE BETWEEN TWO POINTS IS A STRAIGHT LINE
STOP THAT EVERLASTING FUSS, WILL YOU
WOW
WOW!
HAT PIN
GO TO BED AS STRAIGHT AS YOU CAN GET THERE
YES GIT
THIS USED TO BE A DINING ROOM SEE THE HOLE
ACCORDING TO MODERN MECHANICS I CAME TO BED JUST AS STRAIGHT AS I COULD GET THERE
HE CERTAINLY WILL BE AN ENGINEER
WHERE'S THAT PIE?

MODERN MECHANICS In Plain English

Vol. 30 FEBRUARY, 1915 No. 2

WHERE EAST AND WEST MEET

The West is modern and progressive. The East still builds by the methods used at the Tower of Babel. The accompanying illustration shows an addition to the Grand Oriental Hotel at Colombo, Ceylon, under construction. Contract for the structural steel work was let to a European company which proceeded to erect it promptly and in the most modern style, using derricks and air hammers to expedite the work. As soon as the framework had progressed far enough, another contract was let to natives who proceeded to fill in the brickwork according to their own ideas. Bamboo scaffolds were erected, all tied together with ropes, and by means of bamboo ladders the bricks were carried up and leisurely put into place. The steel workers had forgotten all about the work before the natives had the brickwork finished. In the upper part of the photograph the steel framing can be seen going up in the modern way, while in the foreground a network of primitive bamboo holds sway. Kipling was right when he maintained that the East was not to be hustled.

The Ancient and the Modern Methods of Building Construction: In the Upper Left Hand Corner is seen the Structural Iron Work, and at the Right, the Native Bamboo Scaffolding.

Not only are the Oriental methods quite primitive as compared to those of the Western peoples, but at the same time they are usually the direct opposite of Occidental practice. And considering the crude machinery at their disposal, the Orientals deserve praise.

PRESENTING a collection of facts gathered from various sources, bearing on the efficacy of the German Zeppelins as well as the protective measures adopted by Great Britain to repel aerial attacks.

WHEN Louis Bleriot, the well-known French aviator, flew across the English Channel in one of his earlier monoplanes and landed near Dover, the feat was proclaimed as a great event in aeronautics. It was one of the first proofs of the practicability of the heavier-than-air machines for travelling from one point to another, over land and sea. But this same feat had another aspect of even greater importance, although perhaps not so conspicuous. For England it meant that the British fleet no longer was an insurmountable barrier against invasion by a hostile force. A new way was open—the air.

Since England's entrance into the European fracas an aerial attack on London by German airships has been a paramount threat. There have been persistent rumors of extensive preparations taking place in Germany for an invasion of England by an armada of Zeppelins, as well as an aerial attack on the British fleet. On the other hand, reports emanating from sources favorable to the Allied cause have indicated that adequate preparations were made to frustrate any attack by a German air fleet.

To vouch an opinion on aerial supremacy in absence of proofs is foolhardy, but the facts are interesting.

Dreadnaughts of the Skies

Everyone knows that a Zeppelin airship is a gigantic, cigar-shaped aluminum envelop containing seventeen or more gas bags that are held in place by a metal framework. Below the metal envelop are suspended the engine rooms and the quarters for the passengers. The earlier Zeppelins were some 550 feet in length and capable of speeds varying from 40 to 52 miles per hour. The cruising capacity was 1,200 miles, carrying 1½ tons of explosives, while altitudes up to 10,000 feet were attained.

A maze of mystery surrounds the actual number of Zeppelins in existence before the war and since August. According to a recognized and unbiased authority, Germany possessed twelve Zeppelins at the outbreak of hostilities, while another authority claims at least forty-five, adding, in the way of explanation, that the German government took every precaution to prevent the actual number of Zeppelins on hand from becoming common knowledge.

Irrespective of the foregoing controversy, it is a pretty well established fact

that since the first of August the airship factories have been working day and night. One report has it that 1,000 workmen are employed at the Zeppelin works at Friedrichshafen, divided into day and night shifts. These men only assemble the airships, sections coming from all parts of Germany. There a Zeppelin can be assembled in three weeks. Another report states that the joint output of the works at Friedrichshafen and Potsdam is six machines per month. And aside from these two airship factories, there are several others in different sections of the country. If we are to give credence to these reports, there is not the slightest doubt that Germany has ample airships ready for instant use.

It is understood that within the past year a new and more powerful type of Zeppelin has been taking its place in the German aerial forces. A veil of secrecy prevents detailed descriptions of these monstrous air craft from reaching the outside world. These new machines, or super-Zeppelins as they have been styled, are of the same general design as former Zeppelins but highly improved in many respects, especially as regards their equipment for the purposes of warfare. As to their size, here is an interesting quotation from the letter of a correspondent to a British trade journal: "On November 5th the latest and most powerful Zeppelin ever built sailed north direct from the works (at Friedrichshafen) without any trials. It was 1,300 feet long, about 45 feet wide, and had three 800 horsepower motors, and had thirty officers and men aboard." It is hardly believable that this report is true, yet nevertheless it is typical of the many received from travellers returning from Germany.

To repel attacks by hostile aircraft, the super-Zeppelins are fitted with a number of guns, usually two-inch quick-firing pieces. Aside from those carried in the suspended cars, two or more of these guns are placed on top of the metal envelop; these being placed on platforms that are reached by means of a stairway passing through the envelop.

The one great handicap of the earlier Zeppelins, and for that matter all lighter-than-air craft, is said to be overcome in the super-Zeppelins. A German authority has recently made the statement that a newly discovered, non-inflammable, lighter-than-air gas now supplants hydrogen in the new airships. Furthermore, aluminum has been replaced by a new metal that possesses greater tensile strength yet is lighter in weight.

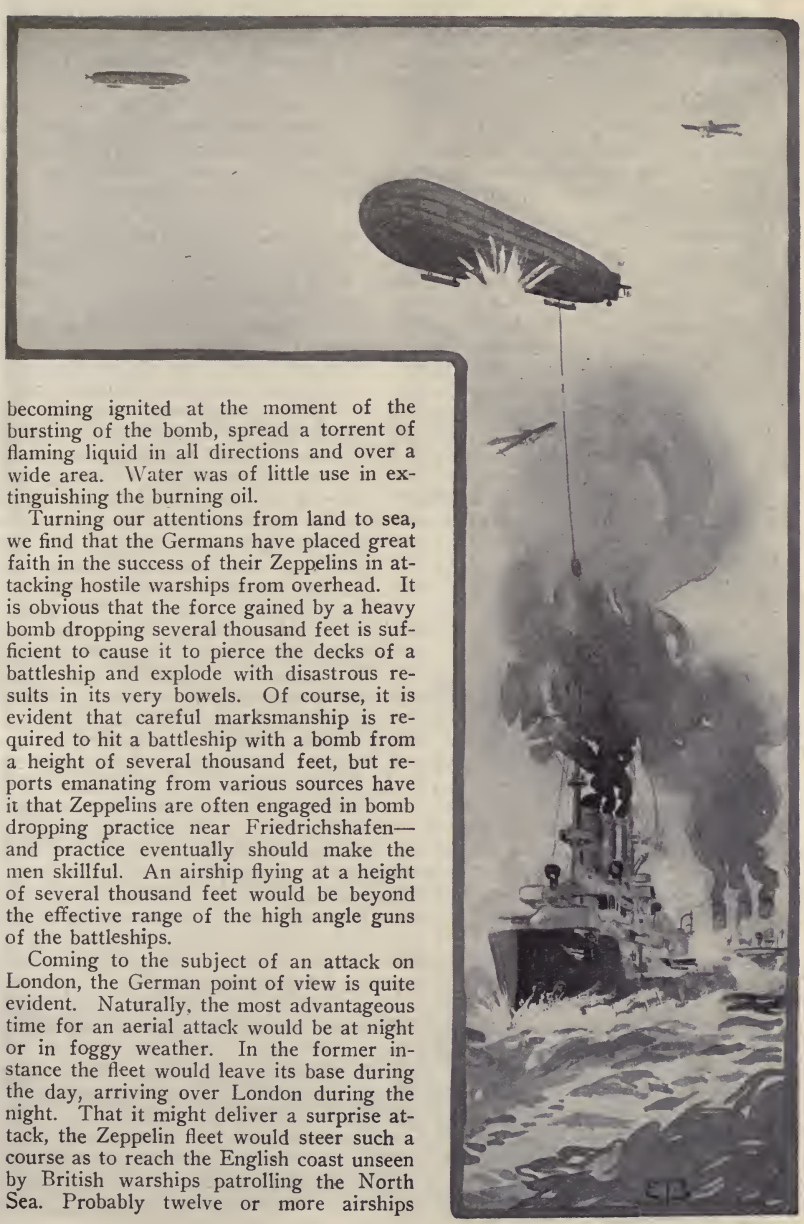
The one striking feature of the Zeppelin dreadnaughts is the suspended armored cage which they are said to carry several thousand feet below them, suspended on one or more steel cables. In the cage an observer can secure a better view of the ground below, while he can aim the bombs with greater accuracy

than would be possible from the decks of the airship itself, perhaps 2,000 or 3,000 feet above. Furthermore, it is often possible for the craft to conceal itself securely behind low hanging clouds while the man in the cage below is lower than the clouds and in full view of the landscape, yet presents but a poor mark to hostile fire.

Showers of Destruction

It is rumored that at least one Zeppelin took part in the rapid reduction of the fortress of Liége, Belgium. Early reports stated that the steel cupolas of the forts were shattered by the impact of aerial bombs, but the facts in the case are very vague. Even the Germans themselves prefer to give all the credit to their huge howitzers, hence the Liége aerial attack—if it ever did take place—proves nothing of moment for the Zeppelins.

It is in the bombardment of cities at night that the Zeppelins have really proven serious menaces. Take, for example, the attacks on Antwerp. The aerial dreadnaughts admittedly struck terror in the hearts of the unfortunate inhabitants. On several nights the airships passed over the city dropping bombs that scattered death and disaster wherever they struck. Yet the explosive bombs were those that caused the least destruction. The greatest menace proved to be the incendiary bombs that were dropped on various parts of the city and started large conflagrations in many quarters. These bombs were filled with petroleum which, on



becoming ignited at the moment of the bursting of the bomb, spread a torrent of flaming liquid in all directions and over a wide area. Water was of little use in extinguishing the burning oil.

Turning our attentions from land to sea, we find that the Germans have placed great faith in the success of their Zeppelins in attacking hostile warships from overhead. It is obvious that the force gained by a heavy bomb dropping several thousand feet is sufficient to cause it to pierce the decks of a battleship and explode with disastrous results in its very bowels. Of course, it is evident that careful marksmanship is required to hit a battleship with a bomb from a height of several thousand feet, but reports emanating from various sources have it that Zeppelins are often engaged in bomb dropping practice near Friedrichshafen—and practice eventually should make the men skillful. An airship flying at a height of several thousand feet would be beyond the effective range of the high angle guns of the battleships.

Coming to the subject of an attack on London, the German point of view is quite evident. Naturally, the most advantageous time for an aerial attack would be at night or in foggy weather. In the former instance the fleet would leave its base during the day, arriving over London during the night. That it might deliver a surprise attack, the Zeppelin fleet would steer such a course as to reach the English coast unseen by British warships patrolling the North Sea. Probably twelve or more airships

would partake in the raid, possibly—but very doubtfully—accompanied by numerous aeroplanes. The air fleet would suddenly appear over London, with engines muffled, followed by a downpour of explosive and incendiary bombs. If it were a clear night, searchlights mounted on housetops would soon discover the fleet and direct the firing of almost countless anti-aircraft guns. If the weather were foggy, the enemy would have to rely on its aerial forces to combat the invaders. But it is more than likely that the German airships would make off after the attack, since nothing more could be gained by remaining to face the enemy's reply. An aerial attack on London would have but little, if any, true military value. The effect would be but a moral one.

Aeroplanes, Guns and Aerial Mines

You are probably now of the opinion that the Zeppelins are mighty and invincible engines of war. But you must listen to the other fellow's argument, since thus far we have considered only the German views. After hearing the British side you can compare the two and draw your own conclusions.

To begin with, the English contend that the Zeppelins are too bulky to be of much use, presenting, as they do, a splendid mark for their artillery. The non-inflammable gas statement is considered a myth for many convincing reasons. As for the cage arrangement, the British authorities do not believe it to be practicable. They point out that such a cage would produce a tremendous pendulum motion, even in calm weather, with disastrous effects to the Zeppelin employing it.

Attention is directed to the fact that before the war the Zeppelins were by no means vehicles that could be depended upon for constant service in weather of all kinds. The Zeppelins were known to be fair weather craft exclusively. It is unbelievable that such impracticable craft could be transformed into reliable aerial vehicles in so short a period.

While anti-aircraft guns would undoubtedly serve to good advantage in repulsing Zeppelin attacks in most instances, if the enemy elected to remain, say, 10,000 feet in the air, these artillery pieces would be of little value. The most efficient weapon with which to combat the Zeppelin therefore resolves itself in the aeroplane. The British aeroplanes are swift, small and easily managed—and there are many of them for home defense. These machines are serviceable in almost all kinds of weather. They carry bombs of various kinds that could be used with good effect on Zeppelins, as well as machine guns. Travelling at upwards of 90 miles per hour, it is obvious that a gunner on board a Zeppelin would have a difficult task before him to hit an attacking aeroplane; the swifter craft being capable of rapidly manoeuvering to the most advantageous positions. The main effort of the aeroplanes would be to pass over the Zeppelin and drop bombs on its metallic envelop. Even allowing that the Zeppelins would be accompanied by German aeroplanes, the British claim that the higher speed of their machines would still rest the advantage with them.

Judging from the general tone of the British press the attitude of the English as regards a Zeppelin raid on their fleet is one of indifference. Little seriousness is placed in the German threats and ample confidence is had in the ability of the Royal navy to repel such an attack.

British authorities are inclined to believe the existence of a bomb that can pierce the decks of a modern dreadnaught, and precautions have been taken. The latest dreadnaughts are equipped with heavy armor on their decks. It has been suggested that a strong, wire rope netting, placed over the decks of older, unprotected ships, sloping down on both sides, would serve to deflect bombs from the ships into the water, or at least break the force of the falling bomb. After all, however, the battleship's safety lies in rapid manoeuvering so as to avoid being hit.

Since the latest Zeppelins must present a target that is quite as large as the average dreadnaught, it follows that when it has descended to a point where its intended victim is an easy target, it offers an equally good target to the guns of the ship. There is the suspended cage to con-

tend with, but in all probabilities it would be swaying to such an extent that accurate bomb dropping would be impossible.

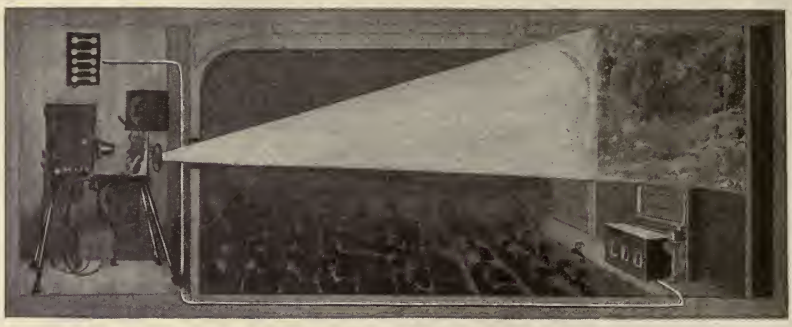
As in the land defense, on water the force below would depend on its own aircraft to repel attacks. The British navy today has the finest and most complete complement of seaplanes of any navy in the world, and any ships that were attacked would lose no time in sending these swift craft aloft to combat the enemy. And these facts are borne out by the recent engagement in Heligoland Bight between British cruisers and seaplanes, and German aeroplanes, Zeppelins and submarines. The Zeppelins partook in the battle but had to withdraw because of the effective fire from the high angle guns of the cruisers. Although the Zeppelins dropped several bombs, none made a hit. This failure was not due to poor marksmanship on the part of the airmen, but rather to the rapid movements of the cruisers to prevent being hit.

While the English authorities cannot give details as to the means they have taken to protect London from an aerial attack, a few of the actual, known precautions, as well as suggested ones, are of interest. It is known that machine guns and rapid firing guns have been placed on housetops and other vantage points, as well as searchlights that illuminate the sky every night. Fleets of swift and armed aeroplanes and their crews are in readiness at the aviation grounds. It is possible that armored motor boats are either now in use on the Thames River or would be available in time for an attack, these boats being equipped with high angle guns.

In time of fog, when the enemy would be most likely to attack, lookouts could be posted on the highest edifices the tops of which rise above the fog. In this connection it must be stated in way of explanation that London fogs often extend but a short distance above the earth. There has been suggested the use of captive balloons at various strategic points; the observers in these balloons being in constant touch with each other and with a central point by means of a telephone system. Thus, if the enemy were discovered approaching, the warning could be sent by telephone and the aeroplane fleets ordered out.

Perhaps the most valuable suggestion is that of employing aerial mine fields around London. The plan consists of placing captive mine baloons to form a screen against airships. Owing to the great size of the Zeppelins, it is believed that forty mines to the mile would be ample. The mines would be so constructed as to explode with great violence on contact. Four men could be detailed to supervise each ten balloons, and the mine field could be easily shifted as occasion demanded. Even if an airship did not come in actual contact with the mine proper, it is possible that propellers or other extending parts would become entangled in the mine cables, bringing the invaders to brief. At any rate, the knowledge of the existence of such a mine field would go a long way towards discouraging an air raid by a hostile air fleet.

The situation at the present moment has been cited in the foregoing. This is a war of surprises and predictions are difficult. Often they are never fulfilled, and more often they are ridiculed by astonishing and unthought of accomplishments. It therefore remains for you to consider the statements and draw your own conclusions.



By a Clever Application of Electric Current, a Piano Player can be Controlled by a Number of Pushbuttons Placed Within Reach of the Motion Picture Operator.

AN ELECTRICAL PIANO PLAYER

A new electrical piano-playing device has recently been perfected by Carl Brown, an inventor of Columbus, Ohio. The device is intended for use in motion picture houses in place of a pianist, thus eliminating the cost of hiring help for that purpose.

The player is placed in front of the usual piano and is controlled from a switchboard located in the operating booth. By pushing different buttons the picture operator can change the music to suit the character of the film appearing on the screen. Instantaneous changes from one selection to another, with change in tempo, are possible in order to keep pace with the rapid shifting of the scenes. In fact, it is claimed that the electrical piano player will keep its music in better harmony with the pictures than the average pianist.

Briefly, the piano player consists of a number of electro-magnets placed in a row and actuating armatures that are connected to a series of fingers overhanging any piano keyboard in front of which the device may be placed. Five trackers are also included with music containers below them. Each container has a capacity of 10 to 12 musical selections similar to the usual perforated paper rolls and made up into endless rolls. Instead of the regulation holes in the trackers, electrical contact pins are inserted. A metallic brush rides on the music paper directly over the tracker pins, making contact with the pins and actuating the magnets whenever a perforation comes in line.

BRIDGE SPANS A FOREST

Near North Vancouver, B. C., there is a remarkable suspension bridge that is more than 400 feet in length. This bridge, which is used to cross a ravine, is 220 feet from the bottom of the forested depression. The structure is entirely unsupported except at the ends. As one walks along this suspension bridge, the effect of looking down on the tops of tall trees is said to resemble that of looking from an aeroplane.

Remarkable Bridge.

A NOVEL WATER MAIN AND ITS LAYING

THE Fifth Borough of Greater New York is the Borough of Richmond, which occupies Staten Island. In years past much fault has been found with the local water supply because of its alkaline content. To overcome this, the engineers of the metropolis planned to link Staten Island with the great aqueduct leading from the Catskill Mountains. The difficult part of the problem lay in effecting this junction between the Brooklyn terminal of the aqueduct and the mains of Staten Island.

An Unusually Clever Engineering Undertaking: Assembling the Sections of a Water Supply Main and Lowering them to the Bottom of New York Harbor.

There is a point between Staten Island and the Brooklyn shore called The Narrows, through which nearly all of the ocean shipping passes, and this same bottle-neck to the harbor basin constitutes the prime passageway for the out-bound city sewage. The swiftness of the tidal currents, the deep deposit of silt and the presence of drainage refuse, combined with the traffic circumstances, hampered the engineers in finding a satisfactory solution. As the connecting main was to have a diameter of only three feet it was not practicable nor economical to think of driving a tunnel of that limited width, and it was manifestly clear that the pipe would have to be laid from the surface, inasmuch as a diver could not work in the current-swept waters nor be able to see in their muddy depths so as to seal the sections as they were laid.

The engineers of the Board of Water Supply finally evolved a type of flexible

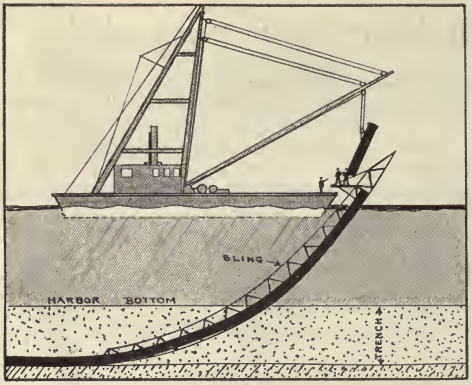


Diagram of the Method Used in Laying Water Main.

metal-packed joint, that could be made certainly watertight with a limit of flexure of ten degrees. The arrangement is on the order of a hollow ball-and-socket joint. By means of a cradle or sling, each section is made up above the surface of the water, and as the main is thus lengthened, the pipe sinks bottomward and rests in a trench dredged deep enough to shield the main—when the excavation is filled—from the anchors of ships. It has taken the city engineers many months to develop a satisfactory joint and their success blazes the way for kindred operations where conditions make it necessary to do the work speedily, to obstruct the channelway for the briefest possible while, and to insure success in the way of water-tightness without having recourse to the costly and the uncertain work of divers. This is probably the first time that this method of laying underwater pipes has been used.

MAKING THE CITY BEAUTIFUL

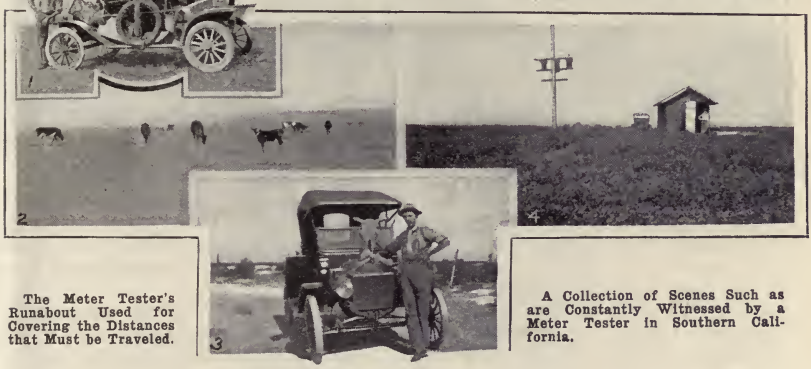
The Old-time Practice of Using Poles for Supporting Overhead Electric Wires.

The two accompanying views show concretely the effect in making the city beautiful of the removal of telegraph and trolley wire poles from the main streets. The telegraph and high power electric wires are strung through the alleys while the supports for the trolley wire are anchored in the walls of buildings. The views were taken at the intersection of State and Commercial streets, Salem, Oregon, before and after the wires and poles were removed

A Modern Street Scene, Showing the Elimination of Poles and Overhead Wires.

Over the Sands With the Meter Man

BY C. A. DOUGLASS



The Meter Tester's Runabout Used for Covering the Distances that Must be Traveled.

A Collection of Scenes Such as are Constantly Witnessed by a Meter Tester in Southern California.

THE meter tester's life in some parts of the west can hardly be called monotonous and as evidence of this, the writer offers the accompanying pictures taken while employed as meter tester by a light and power company serving 45,000 square miles in the San Joaquin Valley of California.

It may be said, as an introduction, that much of the agriculture of this valley is fostered by irrigation; the water employed being handled by electric pumps. To test the meters that measure this consumption of current requires travel over considerable distances.

A substantial runabout serves to carry the meter tester and assistant. They are equipped for a week's outing, each being supplied with a suit case of clothing. Shovel and pick, and block and tackle are included in the outfit, for there is danger of getting stuck in the sand or mud. Tools and instruments are carried in special cases to withstand rough usage, but by far the most important of all is the water bag. When picture No. 1 was taken the thermometer stood at 127 degrees in the shade. On such torrid days the water bag is indispensable. The cattle in picture No. 2 are apparently feeding. However, such is not the case; picture No. 3 plainly showing what happens to cattle relying for food entirely upon the vegetation found on these barren wastes. Water in this region is practically unknown unless supplied from wells.

Picture No. 4 shows what the "good cows" that come home nights eat—and they get lots of it. This is an alfalfa field almost ready for the fourth cutting of the season. It has an electric pumping plant for supplying water from wells for irrigation. These wells range from 30 to 200 feet in depth, the water being raised by electrically-

An Elaborate Real Estate Office which will Eventually be the Center of a Thriving Town.

Two Views of the Sites Formerly Occupied by Hydro-electric plants that were Destroyed by Spring Freshets.

operated pumps. The motors in nearly all cases are directly connected and range in capacity from five to 100 horsepower. The power in all cases is measured by a standard make of integrating watt-hour meter connected in the circuit at all times, although the rate for power in this particular section, used for pumping, etc., is about $50.00 per horsepower per annum, based on the indicated horsepower at various times.

Picture No. 5 is a view of the beginning of a Californian town in that section A real estate syndicate is its godfather. This place lies in a great agricultural district and will eventually be a thriving little town.

The Mt. Gains Gold Mine which is Entirely Operated by Electricity.

Picture No. 6 shows the site of a former hydro-electric plant, the ruins of which can be seen in the river bed, the plant having been destroyed by a spring freshet. This dam is on the Merced River, 18 miles south of El Portal, the entrance to the world-famous Yosemite National Park. Picture No. 7 is the former site of another small hydro-electric plant. This plant was destroyed at the same time as the one shown in view No. 6. Its location is Merced Falls, also on the Merced River. The next view is of the famous Mt. Gains gold mine. This is a 20 stamp mill operated entirely by electricity. This mine is located sixteen miles from the nearest railroad point, and the road to it is the worst I have ever gone over in an automobile. My assistant driving and viewing the scenery at the same time came very near being the "finish" of the two of us on this trip.

Picture No. 9 shows an irrigating canal. The water in this canal is lifted into it by electrically-operated pumps. In this instance, two 200-horsepower motors driving 60-inch centrifugal pumps, are used. The water is taken out when desired with smaller pumps that are also electrically-driven. This canal in question is owned by a private concern and the water is used exclusively on their ranches. Electricity is again called upon at the barns and ranch houses for driving feed choppers, cream separators, churns, etc.

In view No. 10 is seen a small reservoir in which the water that is not needed for immediate use is stored. The electrically-driven pumps operate 24 hours per day without interruption during the irrigating season, which is from May to November in this section.

Picture No. 11 gives an idea of the method used in transporting baled alfalfa hay from the ranches to the railroad for shipment to the markets. This train of three wagons is drawn by fourteen mules, the entire train being driven with one line.

The next picture shows the type of transformer and switching stations used.

Here the voltage is stepped down from 60,000 to 10,000 for distribution to the pumping plants. The transformers, as will be noted, are outside. The building contains only the automatic oil switches.

The cost of testing the electric meters on the consumer's premises, requiring an automobile to cover the large territory, is approximately $15.00 per day. This figure, of course, allows a fair wage for the tester and his helper. However, if one doesn't wish to work and work hard, he had best not go out for this class of meter testing. While it will most likely appeal to those with inclinations for adventure, it is a very trying task.

Various Views of Farming Activities in Southern California. Electricity is Employed in Every Possible Way to Make the Work of the Farmer a Pleasure Rather Than a Task.

THE LIGHTEST EVER BUILT

The three men as seen in the illustration are supported by the lightest structural member ever built. Their combined weight, which totals five hundred pounds, deflects the girder but one inch from the horizontal. It is 22 feet in length and tapers from six by six at the larger end to six by two and one-half inches at the smaller.

The entire girder weighs but fourteen and a half pounds, which is truly remarkable, and was accomplished through the aid of engineering mathematics in the hands of a mechanical engineer who has been experimenting and lending his skill and knowledge to the furtherance of the science of aeronautics in many ways.

The girder may be described as a lattice girder. It is built up of wood with a cloth cover to protect it from the

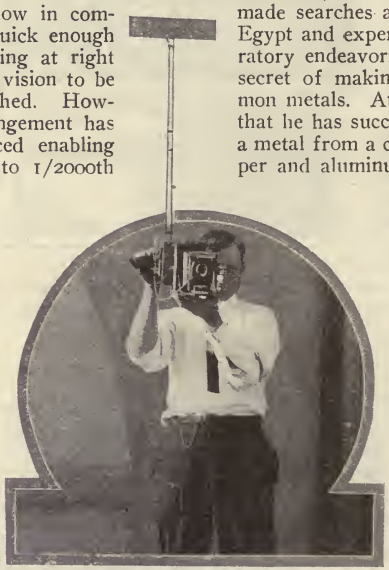
Capable of Withstanding the Weight of Three Men, this Aeroplane Girder is Extremely Light in Weight.

action of moisture; and has twenty panels. To reduce its weight, holes are bored in the material wherever possible.

ELECTRICALLY OPERATED HIGH SPEED FLASHLIGHT ATTACHMENT

Most photographers find to their dismay sooner or later that the fastest of flashlight powders cannot be depended upon to explode quicker than about 1/30th of a second. This speed, which is very slow as compared to fast instantaneous shutters now in common use, is scarcely quick enough to enable objects moving at right angles to the camera's vision to be successfully photographed. However, a flashlight arrangement has recently been introduced enabling exposures of 1/100th to 1/2000th second to be taken with a comparatively slow flash.

In principle, the operation of this device consists of electrically igniting the flash and immediately afterwards releasing the shutter of the camera at the instant that the flash has attained its maximum brilliancy. When not in use, the entire mechanism of the attachment, including battery, can be carried in the pocket. It can be used in conjunction with any camera.



On Pressing the Shutter Release Button of the Camera, the Flashlight Charge is Electrically Ignited.

WIRELESS STATIONS

Germany has seventeen wireless stations in operation, eight of which are on lightships. France has eighteen stations. Russia has twenty-eight wireless stations. In Austria-Hungary there are four important radio stations. The range of most of these stations is carefully concealed by the governments.

SYNTHETIC GOLD MADE FROM COPPER AND ALUMINUM

Since the dawn of history it has been the dream of chemists to change various common metals into pure gold. In fact, the ancients are said to have possessed a secret process for changing baser metals into gold and to-day there is a door of synthetic gold in a Berlin museum that was brought from the excavated ruins at Herculaneum.

For thirty-two years a certain Lewis C. Smith, of New York City, has made searches among the ruins of Egypt and experiments in his laboratory endeavoring to discover the secret of making gold from common metals. At last he announces that he has succeeded in producing a metal from a combination of copper and aluminum, as well as several other special ingredients the nature of which he will not divulge. He calls the metal "Dirigold" and states that it may be melted fifty times over without losing its color. It is said to possess the malleability, texture and homogeneity of pure gold. Furthermore, salt water has no effect whatsoever on Dirigold. Nitric acid affects it slightly more than gold. Otherwise, the new metal is to all intents and purposes pure gold, yet it costs less than plated silver.

A log raft containing one million feet of cedar, said to be the largest ever floated on the Pacific, recently made the trip from British Columbia to Puget Sound. It was 100 feet long and 70 feet wide; it stood 15 feet out of the water and 20 feet under.

A White Spot Painted on the Street Pavement Aids in Enforcing Traffic Regulations.

WHEEL MARKS ON THAT SPOT MEAN A FINE

If a motorist leaves the mark of his tires on the white spot in street intersections of Pomona, California, it means a fine. Passing on the wrong side of the disc means a lecture from the magistrate and a larger fine. The idea is to eliminate corner cutting and the white spot is painted on all of the street crossings in or near the business district of the city. The local traffic officers claim that it reduces congestion and confusion.

PRIMITIVE WATER POWER DEVELOPMENT

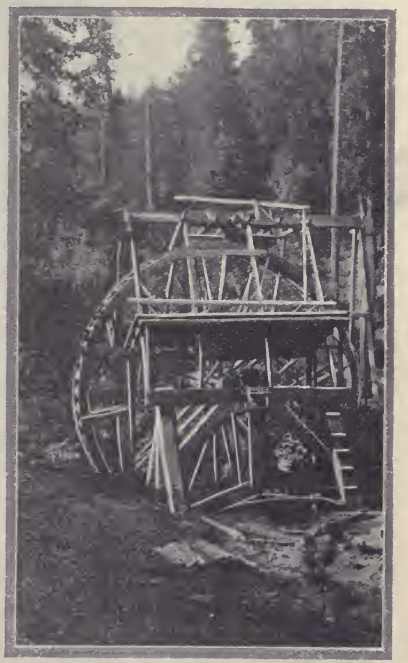
The development of water power was not always the highly finished process it is now. The accompanying view shows a large overshot water wheel, made by an early Californian miner to provide power for running his ore grinding machine. This wheel received water from a sluice at the top and was moved by the weight of the water descending in the buckets on the wheel rim. It was crude and wasteful of power, but it did the work for which it was built.

YARD AND POUND

The British standards of weight and measure, the pound and the yard, respectively, are made the subjects of an interesting ceremony which, every twenty years, occurs at the Palace of Westminster.

Immured in the wall seat of the blank window, on the right-hand side of the second landing of the public staircase leading from the lower waiting hall of the House of Commons up to the committee rooms, are the Parliamentary copies of the imperial standards of weight and measure. They were deposited in this place in the year 1853, soon after the new Palace of Westminster had been opened. They consist of the standard yard measure, made of an alloy of copper, tin and zinc, and the standard pound weight, made of platinum.

The imperial standard yard and pound, composed of similar metals to the copies, are preserved in the Standards Department, where they are kept in a specially made fireproof iron safe, secured by two locks. These measures are protected most carefully against



A Water Wheel Built by a Californian Miner to Drive an Ore Grinding Machine.

the effects of atmospheric corrosion and attrition. The yard rests upon eight equidistant rollers in a compound lever frame, so arranged as to equalize the pressure at the several points of support, while reducing its flexure to a minimum. The pound is wrapped in filter paper and inserted in a light silver gilt case, which is placed in a solid bronze box, the lid of the box being secured by four screws.

There are five Parliamentary copies of the standard, one at the Palace of Westminster, as described, and others at the Royal Mint, the Royal Observatory at Greenwich, the rooms of the Royal Society, and the Standards office. The four last named are compared with each other once in every ten years, and once in every twenty years with the imperial standards, when, also, the copies of the Palace of Westminster are compared.

The ceremony is conducted under the auspices of the Speaker of the House of Commons, assisted by ministers and officials of the Standards Department. The ceremony is quite an impressive and dignified one as it rightly should be.

DIGGING UP NEW YORK'S COLONIAL PAST

Digging for Colonial relics is an unusual hobby. Yet every Sunday two New Yorkers are at work on the side of a hill in the Inwood section of Manhattan Island. They are digging on the site of a British encampment of the Revolutionary War period, and have found many articles such as regimental buttons, old bottles, dishes, belt buckles, lead bullets and flints for muskets.

RICE SACKS NOW SUBSTITUTE CINDERS ON RUNNING TRACK

Owing to the scarcity of cinders in California, as well as the impossibility of getting them in large quantities without shipping them all the way from the State of Washington, Walter Christie, the track coach at the University of California, hit upon the novel expedient of using rice sacks as a substitute for them.

Christie experimented on a small track with different numbers of layers of these Japanese sacks woven from rice-straw, which are used in shipping rice in bulk to California from the Orient for the Chinese and Japanese in the state. He found that four layers of rice sacks, with two inches of dirt or sand, then two inches of clay and cinders, and finally on top of the whole, two inches of the best cinders procurable mixed with a small amount of clay, gave the best results in springiness combined with a firm surface.

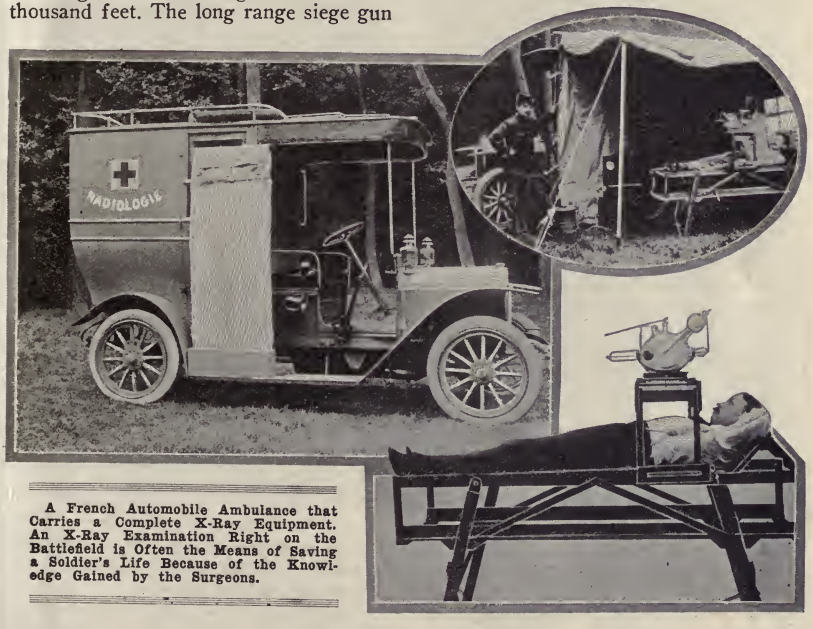
Photo. Rockwell Feature Service

Cinders are Being Replaced by Rice Sacks in Building the New Race Track of the University of California.

The new oval of the university is to be built upon this plan at a cost of $25,000 for excavation and construction work, which is paid from the funds of the Associated Students, an organization of university students interested in all college activities, including athletics and a co-operative store run for the benefit of the students. Over 127 four-horse wagon loads of these rice sacks have been obtained from a nearby sulphur works, which used them for packing glass sulphur bottles, and the enormous mound of sacks has been temporarily stored under a eucalyptus grove near the old running track, where they occupy a space about one hundred feet square.

The X-Ray on the Firing Line

FOR every death-dealing machine that the war inventors-of-the-offense create, the war inventors-of-the-defense must evolve a military or a surgical antidote. Zeppelins are destroyed by the horn-tipped Pathé bomb, trailed from French aeroplanes; invincible dreadnaughts are crumpled under the stealthy blows of submarines guided by aeroplanes; aeroplanes, themselves, disintegrate before the recently perfected Federston vortex gun, which hurls a whirling, shrieking ring of air with crushing force to a height of over five thousand feet. The long range siege gun has not yet found an adequate military counter-invention, but the X-ray ambulance, the latest contribution of surgical-military science, is accomplishing a great deal towards alleviating its carnage.



A French Automobile Ambulance that Carries a Complete X-Ray Equipment. An X-Ray Examination Right on the Battlefield is Often the Means of Saving a Soldier's Life Because of the Knowledge Gained by the Surgeons.

A French army officer, Major Busquet by name, has recently perfected a compact X-ray machine for use on the battlefield. It comprises a photographic dark room, an electric generating plant and the various pieces of laboratory apparatus necessary for making a thorough X-ray examination.

The complete equipment is contained in a staunchly built motor car, resembling a field ambulance. The color is a durable gray; while a bright red cross is blazed in either side over the legend *Radiologie*—"X-ray Ambulance." On the roof is clamped a folded tent, while at the side of the driver a collapsible operating table is strapped securely in place.

In action, the *Radiologie* is certainly interesting. When not in use it is stationed at one of the field hospital bases; and the instant that an emergency call comes in either by telephone, telegraph, wireless or courier, the officer in charge of the *Radiologie* is given orders to proceed *vitement!* to the scene of trouble. The motor is started and the machine

vanishes with a roar in a swirl of dust, bowling and pounding over an uneven road—often no road at all—on its errand of mercy. It would seem that this rough handling would be ruinous to the fragile X-ray bulbs, but an ingenious method of packing absorbs the shock and renders it entirely harmless.

As the *Radiologie* nears the section of the firing line to which it is destined, a protected route, if available, will be carefully picked out and followed. If it is necessary to cross shell- and bullet-swept clearings, the flag of the Red Cross—a crimson cross on a white field—will be raised, so that the *Radiologie* will not be mistaken for an ammunition automobile and shelled by the enemy. A single high power bullet or the smallest fragment of a shrapnel projected through practically any part of the enclosed room at the rear of the car would permanently disable the delicate apparatus.

When the X-ray ambulance arrives at its destination, the tent is erected, the operating table is unpacked and unfolded, and the wounded man is placed upon it. An adjustable framework, supporting the X-ray bulb, is attached to the table top after the patient has become reposed. The ingenious construction of the frame provides a flexible adjusting arrangement so that any part of the body may be conveniently brought within range of the rays and the photograph made without difficulty.

While the frame and bulb are being adjusted and the plate is put in place for the photograph, assistants are making various preparations with the generating mechanism. Besides supplying the current to the induction coil, which is used for producing the enormous voltage required for operating an X-ray bulb, other wires are led to the tent for illuminating purposes. The generating plant consists of a dynamo geared directly to the car motor and used for charging a large storage battery, so that current is at all times available whether the car is running or stopped.

After these preliminaries are attended to, and the sensitized plate for photographing the wound is fastened in position, the roentgenologist gives a low command; there is a momentary sizzling and crackling as the thousands of volts of pent-up electricity hiss violently along the insulated wires—and the exposed plate is hustled into the developing solution. *Voila!* Within ten minutes the surgeon who will perform the operation knows precisely the nature of the wound; knows to the fraction of an inch the location of a bullet, of shell fragments or splintered bones. The painful and dangerous preliminary probing is happily obviated. The patient's chances for recovery are several hundred per cent. greater than if the old method had been employed.

The ingenuity displayed in the design of the various parts of the X-ray ambulance is amazing. The rear compartment of the car furnishes a commodious dark room for developing the X-ray pictures—a room which for actual convenience and for completeness of photographic appointments can hardly be surpassed in the most thoroughly equipped of commercial studios. Cupboards full of variously labeled developing chemicals are placed within easy reach, while water tanks and large developing trays are to be found in their logical places. An electric ruby lamp, fed by the regular generating equipment, furnishes the necessary light for the developing process.

Just how successful the X-ray car will ultimately prove to be is, of course, a matter that the capriciousness of the war itself can alone determine. The first several weeks of its employment by the surgical service of the French army were singularly successful; and there is no reason to believe that it will not continue to perform valuable services during the remainder of the struggle.

Probably the most striking feature of the *Radiologie* is its ability for performing night service. On the roof a powerful searchlight is mounted, and levers manipulated by the driver direct the shaft of light, so that battlefields, after night has fallen and the firing has ceased, can be carefully explored for wounded soldiers whose injuries might be more easily cared for if an X-ray examination were given.

A VIEW of the Pedro Miguel Locks of the Panama Canal at night. These locks are illuminated by powerful electric lamps mounted on ornamental posts. By virtue of the efficient lighting system installed throughout the entire length of the canal, it is possible for vessels to pass through the water way at night as well as during daylight. The illumination of the locks is an important aid in the guarding of these important sections of the great canal.

Photo. by Underwood & Underwood.

A remarkable view of the funeral of Lord Roberts in France. The services were held in a French hotel, a portion of which was temporarily converted into a chapel. Lord Roberts, one of England's greatest military men, died while with the British army in France. His death was sudden and unexpected, the result of a cold contracted on the battlefield and that rapidly developed into pneumonia. He died on November 14th.

Above: A hastily constructed shelter used by English soldiers now fighting on the Franco-Belgian frontier. With the intense cold of winter to contend with, the soldiers of the Allied armies are resorting to every conceivable means of shelter. In some instances great ingenuity is displayed.

Above: the ruins of the Cathedral at Nieuport, Belgium, following the bombardment of the town by German guns. This town, which has been the center of severe fighting, is now reported to be a mass of ruins.

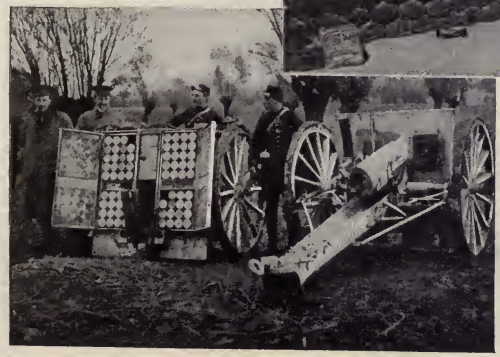
At the right, Brussels, the capital of Belgium now occupied by Germans, is the scene of soldiers in many different garbs. A typical street scene such as the one shown, discloses German marines, German infantrymen, German Red Cross attendants, and Belgian Civic Guards.

Photos. Copyrighted International News Service.

A group of French soldiers attached to the aviation corps. In this view, taken in the Flanders region, the men are at work changing the Gnome rotary engine on a military biplane. The aviators are supplied with all the spare parts necessary, including new engines, in order to keep this important arm of the army in the most efficient state.

A deserted gun ditch and railroad track used by the Germans in operating their huge 42-centimetre howitzers. These huge ordnance pieces require a special foundation to withstand the tremendous recoil.

Piles of ammunition and provisions stored by the Japanese army for use during its attack on Tsingtau and the occupation of Shantung. The Japanese army moved with remarkable precision and carefully prepared for their successful attack on the German possession in China.



A close view of one of the French 75-millimetre field guns and its ammunition caisson. These guns are of approximately 3-inch calibre and are noted for the rapidity with which they can be served. The shells fired by these guns explode about ten feet above the ground and shower shrapnel downward with telling effect. The Russians are using French 75-millimetre field pieces of an earlier model.

Photos. Copyrighted International News Service.

Wounded Indian troopers who took part in the Battle of Flanders. This view is worthy of note, since it bears out the interesting fact that more than half of the wounded in the Allied armies have been hit by shrapnel and usually in the left hand.

Destruction and reconstruction are two of the most important duties assigned to the engineering corps of both sides in the fighting in the West. Here are seen several German military engineers rebuilding a bridge over the Aisne River in France, which was destroyed by the retiring French troops.

A ruined French village along the Aisne River, laid waste by German shells. From an American point of view, it appears that more private property has been destroyed in the European war than actual military defenses. It would seem that the soldiers avenge themselves by destroying the homes of the non-combatants.

Photos. Copyrighted International News Service.

Posters and signs of all kinds figure conspicuously in the recruiting campaign in England. A typical example of this means of inducing the eligible men to join the British army now fighting on the Continent is presented in this view of the Carleton Hotel in London.

"One must live," or what happened to a chicken when it met a Turco. While the soldiers of the Allies are well fed, according to reports, they cannot be blamed for occasionally enjoying a chicken dinner when luck is with them in finding a stray fowl.

British soldiers searching a house between Nieuport and Dixmunde, as a result of having received notice that Germans were concealed there. Spying on both sides is indulged in to a great extent. Although the penalty for those who are caught is death, there are many constantly offering their services on both sides.

Photos. Copyrighted International News Service.

A scene at a British reinforcement camp in France. An armed sentry is guarding the tubs of water to prevent troopers using it for washing or shaving. Water has to be brought a considerable distance, and for that reason its use is confined to the most urgent requirements.

In the Harbor of Papeete, Tahiti: Captured German steamer sunk by German cruisers during attack on French Colony. The steamer was the war prize of a French cruiser.

Belgian soldiers entrenched near Ypres. To protect themselves against the cold the soldiers make use of scraps of sheet iron, straw, old pieces of wood, and canvas sheets. In this instance the men have been fortunate enough to secure a piece of canvas which they have stretched over the trench.

When the sea was called to the aid of the Allies: A view in Flanders, showing how the country has been flooded to hamper the Germans. It is said that many Germans were drowned and that they lost numerous cannons and supplies when the Belgians let in the water from the sea.

Photos. Copyrighted International News Service.

An Indian trooper at rest between engagements in Flanders. He is smoking a hookah in the British camp near Ypres. The Indian troops have rendered good service on the battlefields in France and Belgium, and with the Winter weather setting in it is of interest to speculate as to how they will fare, since they are unaccustomed to cold.

A scene in a pass in the Carpathian Mountains, where Austrian soldiers are guarding the railroads. It is important for the Austrians to remain in control of the mountain passes in order to prevent the invasion of Hungary by the Russians.

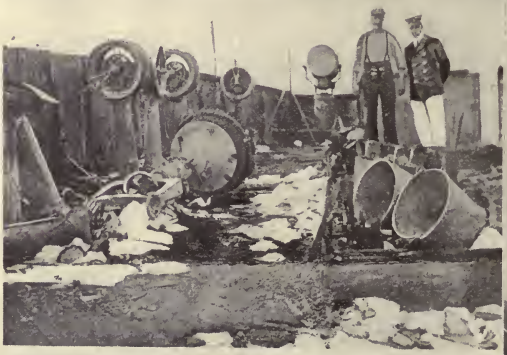
Red Cross aides of the French army attending to a wounded soldier in a ruined church at Nieuport. Efficient medical service on both sides has lessened the terrible cost in human lives to a great degree.

Effect of German bombardment on the town of Ypres. This town has been the center of probably the hottest fighting in Flanders. In attempting to break through the Allies line in Belgium in a great drive towards Dunkirk and Calais, French coast cities on the English Channel, the Germans displayed marvellous courage and persistency, but failed because of the staying power of their opponents.

Photos. Copyrighted International News Service.

A bivouac of Senegalese troops outside Nieuport, Belgium. These are French colored troops brought from the colonies in Africa. These soldiers are said to be fearless of death and formidable opponents in battle.

The horrors of war in the East are similar to those in the West. In this view peasants are seen returning to their homes only to find them a mass of ruins after the passage of Russian and German armies through this section.



Above: Shattered bridge of the armored liner "Carmania" after her engagement with the German steamer "Trafalgar," which was sunk.

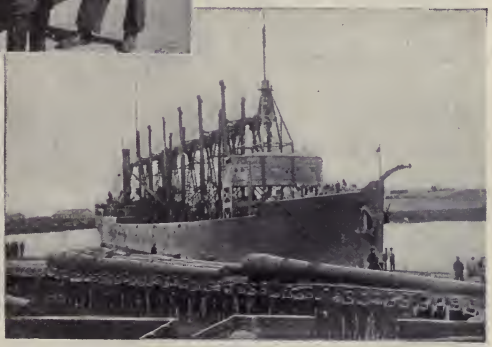
At the right: The lookout of officers commanding an armored train. From this vantage point the officers direct the fire and report results.

Photos. Copyrighted International News Service.

Above: Two of the mortars abandoned by the Germans and brought into Purvyse by the British and Belgian soldiers.

At the right: One of the armored light cars of the British army. Cars of this kind can travel over 40 miles per hour and can carry eight men and driver.

An instance of German preparedness: The motor car used by the German Crown Prince and its special iron framework for cutting wire fences. Little details, such as the fitting of angle iron frames on the automobiles of the officers, were solved and prepared for when the German army began its invasion of Belgian and French territory, to a degree that has claimed the admiration of the entire world.



The American "Christmas Ship" arriving in England: The U. S. collier "Jason" at Devonport, England, with its load of millions of Christmas presents for the unfortunates of Europe. In the foreground may be seen some of the guns intended for British warships.

Photos. Copyrighted International News Service.

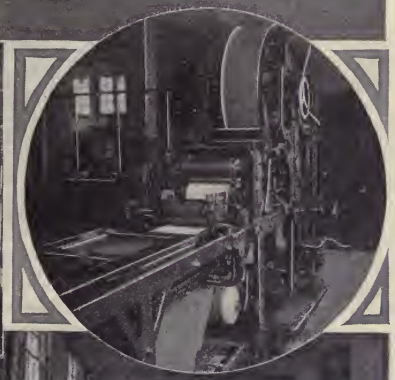
ENGLAND'S INDIAN TROOPS

Not the least remarkable event in the European conflict has been the bringing of Indian troops from their native land to France. In the Hindu contingent now at the front, almost every portion of India is represented: there are Gurkhas from the Himilayan foothills, Sikhs from the northern plain of the Indus, Marathas from the mountains of Central India, the Rajputs who inhabit the western desert, and the Bengal and Madras infantrymen. The Indian troops are excellent fighters, and with them war is considered a sacred undertaking when the cause is a righteous one.

Photos. by Janet M. Cummings.

Various views in the Government Printing Office at Washington, D. C., where United States paper currency, postage stamps, and Government publications are printed. One of the unique features of the printing office is the playground roof used by employees. In the other views may be seen the method of destroying old paper currency, women workers in the bindery, stamp printing machine, applying glue on postage stamps, and engravers at work.

Photos. Copyrighted International News Service.

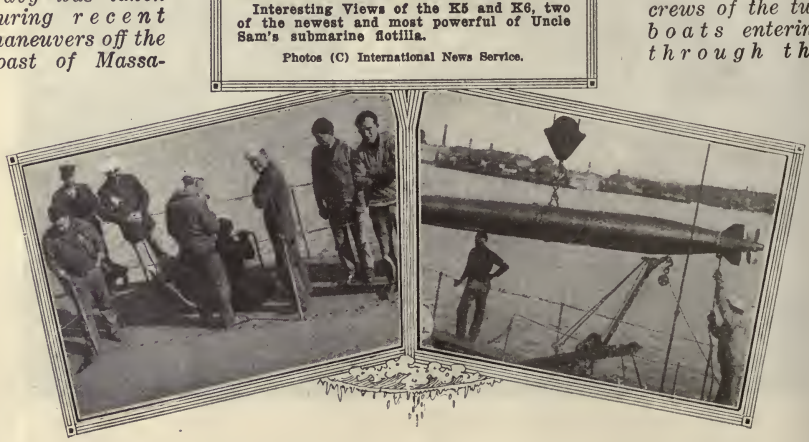


UNDER-SEA FIGHTERS

Interesting Views of the K5 and K6, two of the newest and most powerful of Uncle Sam's submarine flotilla.

Photos (C) International News Service.

THIS remarkable series of photographs of two of the newest and most powerful submarine vessels in the United States Navy was taken during recent maneuvers off the coast of Massachusetts. In the several views may be seen the K5 and K6 running awash or on the surface, and preparing for a plunge beneath the waters; the crews of the two boats entering through the



# of UNCLE SAM'S NAVY

United States Submarines, K5 and K6, in a series of manoeuvres off the Massachusetts coast.

Photos (C) International News Service.

hatches; a scene on the deck of one of the boats showing the conning tower in which the navigator stands; a view of one of the deadly torpedoes as it is being lowered into the submarine; and pictures taken from the observation turret of the K5 and showing the appearance of the bow and stern of the craft as she tears through the water at a high rate of speed, on the surface.

A reproduction from a photograph of a mountain ram's horn that was found imbedded in the stump of a tree. This curious combination was found in the mountains near Salt Lake City, Utah, and no satisfactory explanation has been given as to how the ram's horn became imbedded in the tree trunk.

Photo Janet M. Cummings

Chinese peasants and their crude dwelling. This man and his wife are considered well off in China. They own the home, the furnishings and enough to eat — sometimes.

A popular child actor who appears in Vitagraph productions. Here Bobby Connelly is seen in a film play entitled "Just Bear Facts," with two cubs.

Largest grapevine in the world growing in California, measures nine feet in circumference and covers one-quarter acre of ground. It annually bears from six to eight tons. It was planted in 1842.

Taking Pictures on the Firing Line

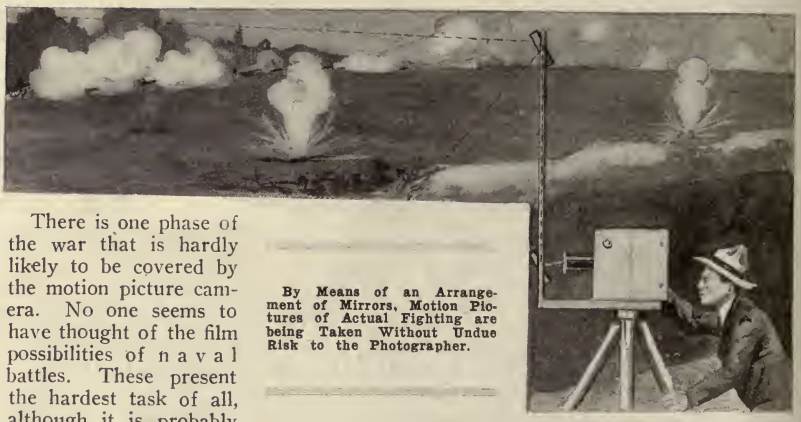
By Ernest A. Dench

THE present war is the hardest proposition that has yet confronted the motion picture camera man. Yet in the face of the seemingly impossible obstacles that have been placed in the way, some camera men have succeeded in surmounting the difficulties and have secured excellent pictures of active engagements. One evidence of success in this direction is presented in the film known as "The Defense of Alost," in which scenes of desperate fighting and carnage are much in evidence. The daring camera man who filmed this engagement was sheltered in the doorway of a house and had only just left his post when the adjoining house was blown up by a German shell. As it was, the camera man was wounded and blood poisoning afterwards set in. This is one of the few instances where fighting has been filmed at close quarters.

The most difficult problem of the camera man's work is when the fighting occurs over large, exposed areas. First of all, in such instances it is most difficult to approach within a convenient distance of the actual scenes of fighting, since the authorities are exceedingly strict and to venture in the direct firing line is to court death. Some of the operators have been equipped with the Aeroscope camera, which contains no heavy tripod. This hand motion picture camera has a wide range of vision and its light weight greatly simplifies carrying it to various parts of the battlefield. Others who adhere to the ordinary, cumbersome film camera will in all probabilities be obliged to conduct their operations from trenches. Both the operator and the camera will be below the surface of the ground, thus protecting both from rifle bullets and shells. One device that is now being used consists of two fixed mirrors that are attached to the camera to serve a double purpose; not only does the device reflect all the action that is taking place in the distance on the lens of the camera, but the operator is also enabled to see what is transpiring.

A much safer method than the one before mentioned is to photograph the battle scenes overhead from a balloon or airship. One enterprising camera man has already secured permission to do this.

Even after the pictures have been successfully obtained there is still a greater power to reckon with—the censor. Many film men have had their films ruined because of the censor insisting on an inspection before the strips were even developed. To avoid such losses as these, some operators often resort to smuggling, risky as that practice is.



By Means of an Arrangement of Mirrors, Motion Pictures of Actual Fighting are being Taken Without Undue Risk to the Photographer.

There is one phase of the war that is hardly likely to be covered by the motion picture camera. No one seems to have thought of the film possibilities of naval battles. These present the hardest task of all, although it is probably quite practicable to record the action from a dirigible. Of course, official permission may have been applied for but not granted.

FILMING THE WONDERS OF YELLOWSTONE PARK

Carl Louis Gregory, who is the underwater photographer of "Thirty Leagues Under the Sea," is whipping the 20,000 feet of film he took at Yellowstone Park for the Thanhouser-Mutual Company into shape for early release. Mr. Gregory is the first motion picture photographer to receive a permit from the Government to take the views.

ACTRESS'S REALISM FOOLS LIFE GUARD

A life guard at Playa del Rey, near Venice, Cal., spoiled a scene in the Reliance-Mutual newspaper drama, "The Floating Call," featuring attractive Irene Hunt in the rôle of the sob sister.

Miss Hunt jumped into the lagoon from the bridge. Director Fred A. Kelsey, with his camera man and other members of the company, stood on the lagoon bank. Miss Hunt, although an expert swimmer, at Kelsey's direction began going through all the evolutions of a drowning person. A life guard was patrolling the beach about a block away. He saw Miss Hunt plunge into the water and immediately started for her at full speed. The life guard cleared the bridge rail, dove head first into the water, seized Miss Hunt and started to swim ashore with her.

He then observed the director and camera man and apologized for spoiling the scene. The life guard said he thought Miss Hunt was trying to commit suicide. The scene was retaken, with the life guard an interested onlooker.

PATHE FRERES TO TAKE MOTION PICTURES OF WAR

It has been formally announced that Pathe Freres have been appointed official cinematographers to the French Government in connection with the war. This much sought for concession will give Pathe a tremendous advantage in the matter of securing authentic and historically valuable pictures of the world's greatest conflict, since it is evident that the prejudice which has existed against the motion picture camera anywhere near the firing line will to some degree be lessened when the cameraman bears his official government commission.

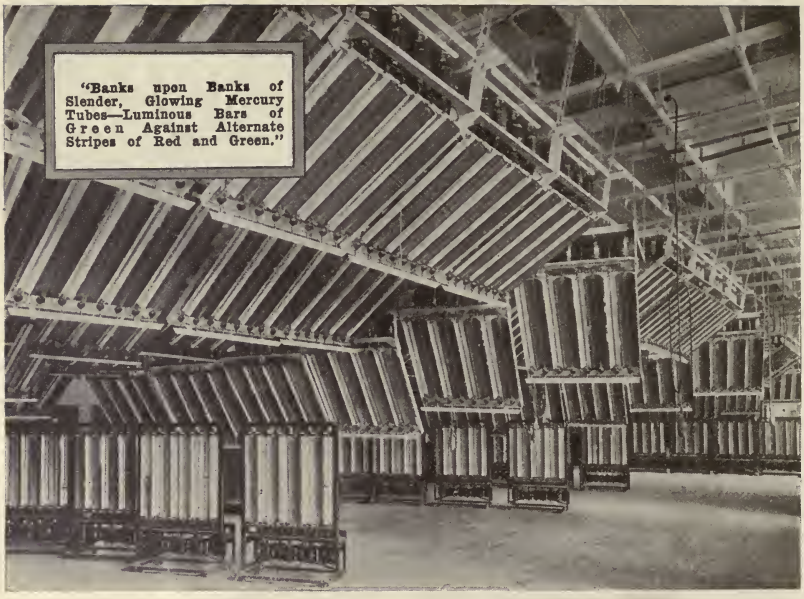
The statement made some time ago to the effect that a branch of Pathe Freres would film the German campaign has been denied.

Artistic Temperament Has Fled Before a New Ideal in the Production of Modern Moving Pictures. "Studio" has been Supplanted by "Factory." The Ivy-Clad Sun Dial has Relinquished its Place to the Time Clock. Hustle and Bustle are Displanting Dreams and Desuetude. Heartless Competition Forced Efficiency into the Movies—and Efficiency is Making Over a Lifeless, Haphazard Experiment into a Highly Organized Industry.

THE glamour of the movies is like the glamour of the stage: it can only be appreciated by those on the other side of the footlights. Making moving pictures on the large scale that some producers do nowadays—several plays a week—necessitates rigid systematizing in every department. Acting is merely a cog in the machine, a single step in the manufacture of a world-wide necessity.

There is nothing romantic connected with a modern moving picture studio, unless it is the romance of business itself. I mean that artistic temperament simply does not exist there; that the photo-play on the screen is so utterly different from the photo-play in the making that it is often quite a disappointment to peek behind the scenes.

Viewed in a cold, critical light, moving pictures, made in the tremendous quantity that they are nowadays, are slowly



"Banks upon Banks of Slender, Glowing Mercury Tubes—Luminous Bars of Green Against Alternate Stripes of Red and Green."

but surely seeking the plane of the canning industry. The idea of "Canned Movies" may grate against your sense of the artistic; yet there is nothing shocking about it at all. If movies were not turned out on the canning industry scale, there would be no movies. The Biograph Company manufactures between two million and five million feet of finished film a week—enough to encircle the world once or twice every year. Obviously there is no room for temperament before or behind the camera.

Artistic Temperament Minus Temperament

The afternoon that I got my first glimpse of the Biograph studio in action, I was disappointed. After I had examined things more closely I had a decided change of mind.

Banks upon banks of slender, glowing mercury tubes—luminous bars of green against alternate stripes of red and green—poured a ghastly, bold light into a drawing room in which there were two lovers. Their skin was a bleached green; their lips, a deathly gray; their smiles—hideous.

"How can they stand it!" I burst out.

"They get used to it," replied our guide. "In time, they look just as natural to one another under that light as under sunlight." We stood there for nearly half an hour before we realized the truth in this statement.

"We use the mercury arc lamp," he explained, "because it is more efficient. Perhaps the actors and actresses would appear a trifle more natural to each other at first under the ordinary arc; but the mercury lamp has wonderful photographic qualities; it is the most efficient light for the purpose we have ever found."

Covering the entire ceiling of the vast studio, thick clusters of the bright tubes cast down their chilly radiance—like the nearby aurora of an Arctic night.

Thousands for Realism

Four or five separate scenes were being photographed in different parts of the studio, each set surrounded by a high

screen. The screen gives privacy to the actors, besides offering an opportunity for the director to concentrate his thoughts and efforts on the difficult task of filming a smooth-flowing, consistent narrative.

The limits to which the Biograph directors will go—are expected to go—in order to give the aspects of truthfulness and naturalness to their films, knows no bounds. These are no idle words. Expense is the last consideration. In fact, it's not a consideration at all.

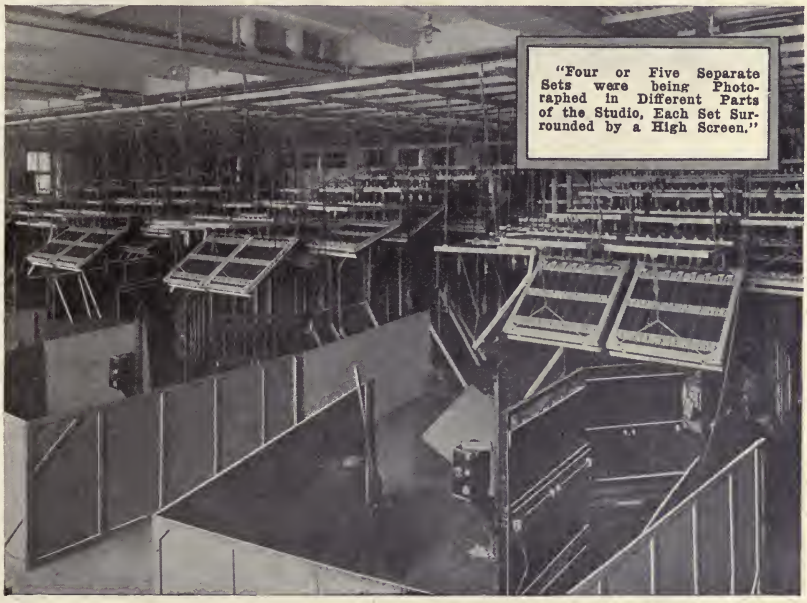
"The day of the faked picture is past," remarked one of the directors. "In Europe, scenery is not an object in any sort of a play. 'Get the acting and let the scenery go hang,' is their motto. Everything is sacrificed to temperament—to 'the art,' as they call it. But the conditions are different on this side of the water. Americans demand accuracy. Even in the cheapest melodrama, you can't get away with the same set for six different acts merely by shifting the position of a tree!"

Down in the property rooms we had seen a carpenter at work on an old, rustic well top. Dirty old boards had been used and stained musk to create realism in the picture in which the well would ultimately be used. Take away the business-like workbench in the background, let your mind wander a trifle, and you could very readily picture a little sunbonneted farmer maid with an oaken bucket on her arm standing beside the well in a green field!

Nothing is too good for realism at the Biograph factory. We inspected a prison set-up in the daylight studio, of which I will have more to say later, and it was so real that it was actually oppressive.

"Reminds me of the time I was arrested for speeding," observed my companion. "I didn't have enough money to pay the fine and the little home they gave me was just like this!"

The most striking illustrations of the extent to which Biograph directors will go in order to produce genuine atmosphere are shown in the ballroom scenes and the boudoirs of wealthy ladies. Whenever, for instance, you see a table



"Four or Five Separate Sets were being Photographed in Different Parts of the Studio, Each Set Surrounded by a High Screen."

in a Biograph picture that looks as if it were made of mahogany, you can rest assured that it is mahogany all the way through. The drawers of every bureau and dressing table we examined were lined with brocaded silk. Some of the more expensive sets are worth $3,000 or $4,000. Although the expensive furniture is usually rented, the rental bill will often amount to $500 or $600. Fashionable ball gowns, which must be made to order, cost from $400 to $1,000 apiece. To paraphrase the speech of a venerated statesman: "Thousands for realism, but not one cent for temperament!"

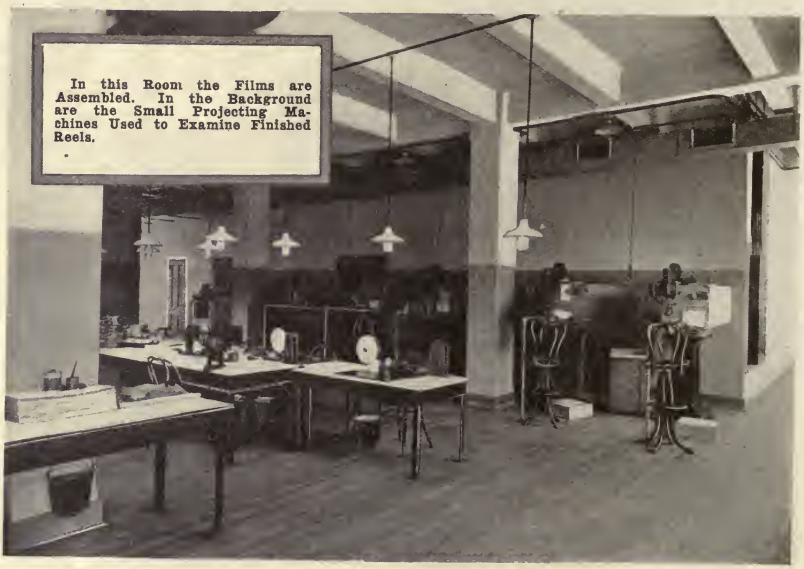
Blue Substitutes White

The Biograph Company has been in the moving picture field for more than eighteen years—longer than any other concern in the world—and they have worked out the countless little problems of picture taking to a fine science. One of the most interesting examples of this is illustrated in the use of clothing resembling white. I say *resembling white,* because the color white is rarely used before a Biograph camera. White displayed openly will cause, in photographic terms, *halation.* That is, a foggy blur about the white object in the picture. To avoid halation, the actors must wear pale blue shirts and neckties and the gowns, dresses and shirtwaists of all the actresses instead of white must be of this pale blue color. In the finished picture the blue appears as a snowy white. Tablecloths and bed coverings are likewise tinted to avoid halation.

While we were watching a hospital ward scene in process of construction, a girl, dressed in the "purely blue" costume of a Red Cross nurse passed by smiling.

"That's Miss Prescott," our friend informed us. "She has one of the sweetest dispositions of all the girls in the movies—on the stage or off."

We saw a number of famous moving picture players at the Biograph studio that afternoon. Most of them I recognized even in their "war paint," having seen them quite often in picture plays at the theatres; and I was fortunate enough to talk with a few. It seemed strange that a man whose gestures I and millions of others had become intimately familiar with by repeated observations at the



On These Wooden Frameworks the Wet Film is Wound and Then Revolved Until it is Thoroughly Dried. The Room is Heated at a Uniform Temperature to Expedite the Work.

movies, should be talking to me in flesh and blood and using these same familiar gestures.

Think of having literally millions of friends all of whom can claim an acquaintance "by sight!" And consider how embarrassing it must be to stroll down the street and, every block or two, after receiving a bold stare, hear someone excitedly whisper, "Oh, there's so-and-so, leading man for the Biograph!"—or Selig, or Vitagraph or Lubin, as the case may be.

Acres of Glass

On the top floor of the largest building of the Biograph group the daylight studio is located. It is an unbelievably large crystal-roofed room, lofty and as bright and airy as outdoors. Here, the enormous banquet and ball room scenes are produced. Perhaps I can emphasize its hugeness to best advantage by mentioning that a Democratic Constitutional convention, very accurately simulating the 1912 convention held at Baltimore, was produced not long ago. Speeches were given, political platforms announced; the smallest details were faithfully carried out.

"In some of our large productions," our guide informed, "we make use of a thousand or more men and women, for mob scenes and the like."

"Do you have any trouble securing them?" we inquired.

"Trouble! We used to advertise in the want-ad columns of the papers; and we have had lines of applicants extending almost all the way around the block. I should say we did have trouble! Now, we get all the supers we need through an employment agency down town. And you would be surprised to see the numbers of fine, capable looking chaps on the super list! There's something about suping for the movies they simply can't resist!"

Flickerless Movies

It is a physical impossibility for Biograph pictures to flicker. This result is brought about by the use of a camera of almost unbelievable weight, mounted on a tripod which, at least by its appearance, could support an elephant with ease! The cost of the Biograph camera would be difficult to estimate. It is of special design; and every mechanical or photographic device which would go toward making an absolutely perfect picture is there. Aside from the infinite pains which characterize every detail of its construction, perhaps the most in-

genious feature is a mechanism which punches out sprocket holes as the picture is being taken. The film moves past the lens in little jerks, equal to the length of a single picture. When each successive unexposed portion is squarely opposite the aperture, a small punch automatically plunges through the rim on either side. The purpose is easily explained. When the finished film, the positive, as it is called, is run through the projecting camera in the theatre, each consecutive exposure as it is thrown on the screen will be exactly opposite the lens.

The Biograph camera is at least four times larger than the normal moving picture machine. Yet all that weight is there for a very definite purpose: camera solidarity means a steady picture. Hence the weightiness of the Biograph camera.

The Bigness of Little Things

You have been told a little about the mechanics of the moving picture stage. Now let us turn for a few, fleeting glimpses into the very interesting process of film treatment.

The first thing that would impress you would be the infinite pains which are taken in every one of the numerous steps of film finishing. A strip of the film of each scene is clipped from the negative before the set is destroyed to determine whether or not the exposure has been correct. Assuming that it has, the consecutive films are glued together in one continuous ribbon, and the picture is shown before a censory board comprising the managing director and the several directors who took part in making the play. The censory room is a veritable sanctum sanctorum and he who enters does so at his own risk. The picture is gone over thoroughly, stopped innumerable times, criticized, sections cut out, scenes rejected—sometimes the whole picture must be done over again.

Once a picture was made in one scene of which a girl went in and out of the house several times. It was a very important scene as it came at about the climax of the story. Of course, the interior of the house was staged in the indoor studio. The unfortunate part about it was that every time the girl left the room she wore a large black sombrero; but as she came out of the house, she had no hat on at all. The managing director exploded for about ten minutes and the scene was taken over again. Such occurrences as these are very rare, however.

A Gnome is Interviewed

Every work room in the Biograph factory is large, airy and comfortable. But you never lose sight of the fact that this is a factory with factory methods and efficiency ideals. A detail which did not escape us—it could not—was that every girl employed there (400 to 500), was well and attractively dressed.

"Their salaries are good because their work requires expertness," our escort advised us. "An efficiency engineer would need a microscope to find improvements for their methods."

The most interesting part of the entire establishment, to me, we found when we visited the printing room where the positives are printed. Thousands of miles of films are made each month for moving picture houses all over the world.

Our guide led us through a confusingly staggered hall—a series of "light breaks"—which prevent the outdoor light seeping in. Only a dim red glow can be used when raw films are handled as they are extremely sensitive.

Except for the sullen chatter of cushioned steel on steel, it might have been some quaint little Japanese tea house. Countless jack-o'lanterns groped with arms of dull, glowing crimson into the engulfing darkness. From out of the black shadows, the voice of a girl singing came mysteriously. This was gnomeland! A score of gnomes were busily at work.

As our eyes became accustomed to the crimson darkness, the low room seemed to expand, to broaden. The rows of shapeless bulks took on the definite forms of intricate, smooth-working machines. Between the rows of machines, on long tables, columns of neatly stacked tins spread out before us under square

red lamps. Occasionally, a forewoman would come up with an armful of tins and carefully put them down beside the others. Or, she would flit back into the darkness bearing a fresh load.

Before every machine—there were probably forty of them—sat a girl operative, vigilantly watching an indicator or twisting a handle or knob. From metal tanks to her left, two ribbons flowed out and met under a masked light. This was the process of printing positives—the finished films which go out to the theatres. As the fresh yellow strip met the transparent-and-gray negative in a clicking steel frame, the masked light from above was flashed on and off automatically. Simultaneously, a perforating machine punched out holes in the edges of the new film for the sprocket wheels of the projecting machine to catch into.

After we had had the operation of one of the printers explained, I asked the girl who was operating it if the red light was not injurious to her eyes.

"Not at all," she replied. "Some of the girls have been working here for seven and eight years, and it hasn't affected their eyes at all."

"How about daylight when you have been working in here for several hours; does that hurt your eyes?"

"Sometimes, but very rarely. We grow accustomed to it in a short while —a few days or a week at the most."

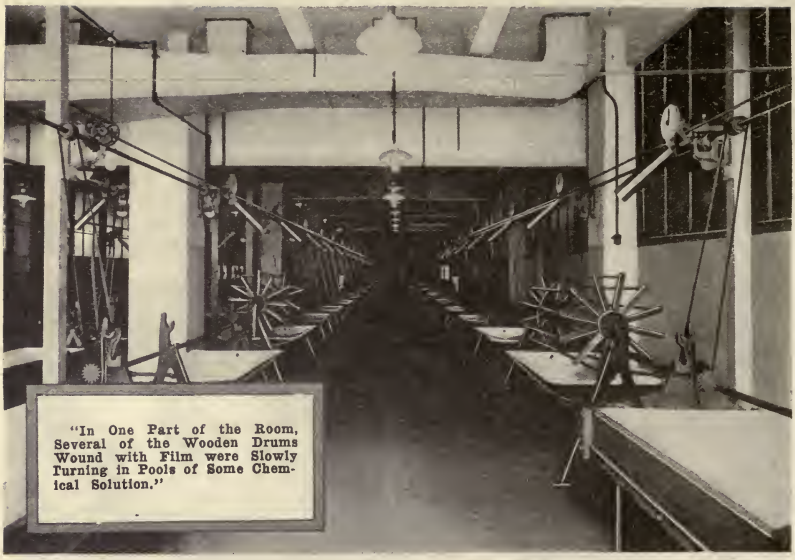
"How well can you see in this light?"

"Just as well as if it were daylight. I can distinguish the features of every girl in the room." She went on about her work, and we groped our way back to the daylight.

Above: A Battery of Printing Machines that are Used in Printing the Positive Film. In the Oval: A View of a Large Film Assembling Room Where Many Girls are Employed in this Delicate Work.

Railroad Semaphores and Cyanide Tanks

As we passed down the stairway of the developing building, we came opposite a window through which a knotted rope passed. An actor dressed as an Irish laborer, was gesticulating wildly to someone below. A man came out from a doorway and stopped us.



"In One Part of the Room, Several of the Wooden Drums Wound with Film were Slowly Turning in Pools of Some Chemical Solution."

"Wait a minute," he requested. "We're dropping a safe on a fellow's head, and you'll get in the picture if you walk past that window."

We waited while the *papier maché* safe slipped its noose and plunged down on the unfortunate below. Then we proceeded to the dark-rooms where the films are developed in great porcelain basins on revolving drum-like frames and on into the staining room where the films are colored for various ultimate effects —red for fire scenes and blue for moonlight and night pictures.

In one part of the room, several of the wooden drums wound with film were slowly turning in pools of some chemical solution. Above each tank, attached to an iron axle, was a semaphore arm, very similar to the semaphores in use on the railroads. Beside it was a large, white, enameled disc.

"The semaphore," explained the foreman in answer to our question, "prevents the film being left too long in the solution. When the process has gone far enough, a time apparatus causes the semaphore arm to fly up and attract the attention of the workman in charge. He knows then that the film is ready to be taken out and washed.

"This solution," he went on to say, "contains cyanide. If a film should be too dark, or 'thick' as we express it, it is run through a reducing bath of cyanide. If the film is 'thin'—too pale—we give it a bath in a mercurious solution to intensify it."

Back You Go!

The scenario department, which we next visited, presented the appearance of an editorial office in the flame of its busiest season. A spacious table in the centre was stacked high with pyramids of long, fat envelopes, stamped, ready for the mail.

"Those?" said a busy young lady, sealing and tossing an envelop on a groaning heap. "Why, they are rejected scenarios. We can only use one out of about every two hundred submitted. Everybody writes scenarios nowadays, you know. And they are nearly all worthless." We knew, for we had tried it ourselves.

"Policemen, school girls, grocery boys, rich ladies—all of them try their hand."

Six scenario editors were busy, reading and rejecting—reading and rejecting. And, contrary to general belief, every scenario received is conscientiously gone over. If it has the germ of an idea, it is set aside and re-read.

Writing acceptable scenarios is not so easy as some people believe.

In this rather limited space I have been able to do no more than touch upon a few of the most striking events in the career of a Biograph film. To go into any greater details would only bury the point that I have tried to bring out—the combined efforts of the workmen of every department to place Efficiency above all other considerations. The Biograph Company has been accused of absorbing the identity of its employees. I mean, for instance, that some persons criticize the fact that directors' and actors' names do not appear emblazoned on the screen at the theatres; that all letters on the company's stationery are signed merely by initial; that a person entering the Biograph studios is simply swallowed up and lost sight of. But that is an unjust criticism. The entire Biograph organization is a highly perfected efficiency machine—a solid, compact unity—the result of everybody's doing his and her level best.

It is an admirable policy with a single and obvious issue: the creation of a delightfully unique personality. And no one who has followed Biograph pictures for any length of time can doubt that they possess a charming and a lovable personality.

TWENTY TONS OF DYNAMITE EXPLODED FOR PICTURE

Twenty tons of dynamite was exploded to lend realism to a film production entitled "Nipped," a powerful story of Japan and the Mexican revolution, made under the direction of Thomas H. Ince.

The explosive was kept for over three weeks awaiting the time it would be employed. It was placed in various boxes that were isolated from each other by thick layers of cotton. The explosive magazine was constantly guarded by armed men. When the dynamite was finally employed its terrific explosion was recorded by eight cameras situated at vantage points. The force of the concussion was felt for a radius of many miles.

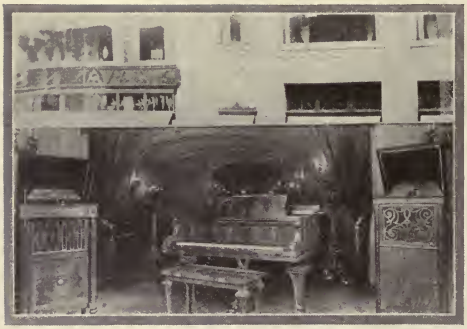
FOREIGN POLICE DOGS TAKE PART IN AMERICAN FILM

German police dogs are used in "The Center of the Web," a two reeler now in the making at the Thanhouser-Mutual studio in New Rochelle. These dogs only recently arrived in this country from Berlin, where they had been used successfully in the tracking and apprehension of criminals. Closely resembling wolves, the dogs made a queer looking pack as they awaited Director Harvey's bidding.

Heavy collars with sharp nails are used to discipline them. When a dog becomes unruly its collar is turned so that the nails quickly restore him to better temper and obedience.

The keepers of the dogs spoke to them in German, as they are not trained to commands in English. One of the dogs, however, understands directions given him in French. This animal was sold for $1,600, but represents such a splendid type of his breed that permission was given by the new owner to work him in the picture.

The ability of these dogs to follow the trail of human beings was demonstrated when two cats and several rabbits were turned loose near them. Not a dog even as much as looked askance. Their keeper explained that if they were trained to follow animal scents they might some time be led astray from the human trail they were following and thus fail in the one purpose for which they are intended—the hunting down of human malefactors.



By the Clever Application of a Curved Glass Window, This Display Appears to be Without a Glass Front.

AN INVISIBLE WINDOW

It is more than vexatious when a store has put in an especially elaborate window display to find that because the window glass is acting as a mirror, reflecting the sidewalk and the buildings across the street, passers-by cannot see the merchandise and figures in the window without flattening their noses against the glass. This is by no means an unusual situation, and nearly every window dresser has had to face it.

In efforts to find some means of overcoming the difficulty, backgrounds in various colors have been tried and wide awnings have been hung above the windows, but these are not very satisfactory or practical remedies. The reflections continue because they are caused by the refraction of light rays from the glossy surface of the glass itself. Nothing placed behind the glass can alter this.

By applying the simple scientific principles of optics a New York store has solved the problem. This store had an apparently useless window on a high-priced frontage—made useless by light reflections. Now the window is so free from glare and reflections that it instantly attracts attention; for, except on close examination, there does not appear to be any window at all, simply a show window open to the air. The eyes of people passing are so accustomed to more or less reflection from show windows that they are caught by the complete absence of reflection. Everyone instantly notices missing plate glass on the morning after a windstorm has blown in a show window.

The remedy for this window was found in a sheet of plate glass bent to such a curve as will reflect exterior rays downward to the inner non-reflecting surface of a barrier. Thus a shadow box is formed and permits a distinct view of the store interior and of the show window itself. Simply stated, the remedy really consists of the substitution of a curved plate-glass window for the ordinary flat glass. It is claimed also that the polarization of light entering the curved glass window—the shadow box window, as it is now called—emphasizes the color and texture of draperies, so that even at a distance of several feet their quality is shown to good advantage.

The new window is safe from accidental damages, both because of its strength, due to its curve, and because it is two to four feet back from a flat glass position, therefore putting it out of the way of most dangers.

The scheme might well be followed with profitable results by other progressive storekeepers.

A Typical Glass Front Showing the Reflection of the Building and an Automobile on the Opposite Side of the Street.

USING PILLOWS AND MATTRESSES AS LIFE PRESERVERS

A resident of Baltimore has recently demonstrated special pillows and mattresses for use on shipboard and which could be employed as life preservers and rafts. In a series of tests before Government authorities the inventor proved that his pillow could be placed about a person more readily and with less experience than the usual cork belts. Furthermore, he demonstrated how the pillow could be placed with equal ease on a two-year child as well as the largest person. The mattresses were likewise tested and proved to be very efficient life rafts capable of holding several people. Both the pillows and mattresses are filled with a water-resisting material that is unaffected even when placed in water for long periods; its floating powers being permanent.

A Newly Invented Pillow that may be Employed as a Life Preserver. It is Filled with Water-resisting, Soft Material.

ALUMINUM AS AN ELECTRIC CONDUCTOR

More or less success has attended the employment for some years past of aluminum for telegraph and telephone wires. Simple joints for the ends of the wires have been devised. Owing to its large volume, the wind resistance of aluminum wire is quite considerable, and for the same reason a good deal of insulating material is required, if it is to be coated.

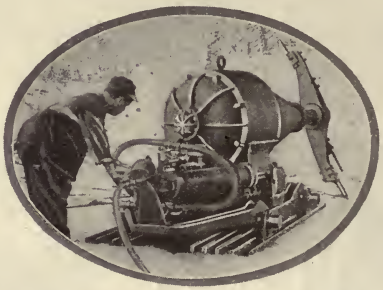
WOOD PRESERVATION

Recent experiments by Government experts have revealed an unexpected source of trouble in the process of sterilizing wood by the injection of preservative liquids. It is customary to remove the bark from a stick of timber before it is subjected to creosoting, but it has been supposed that thin layers of the inner bark left unremoved would do no harm. Now it is found that such layers, no matter how thin, almost absolutely prevent the penetration of the liquid. In any case, the preservative usually fails to penetrate the center of the stick, but forms an exterior antiseptic zone, which answers the purpose if there are no gaps in it. But if such gaps exist, owing to the presence of thin layers of bark, the teredo finds an entrance through them and carries on its work of destruction in the interior of the timber supposed to have been protected.

CARRYING COAL BY PIPE LINE

The proposal to pipe a mixture of pulverized coal and water, as oil is now piped, is not new. But it has been limited in the past to the coal dust produced in ordinary processes of mining and which is often washed. It has never been carried out commercially—at least on any considerable and practical scale.

Two New York inventors now propose to mine all coal in the form of dust with a special machine, mixing it at once with water and handling it thereafter by means of pumps and piping. At its destination the coal is to be separated from the water and dried, after which it is ready for all purposes for which lump coal is now employed in such tremendous quantities.



A Rotary Cutter, Driven by an Electric Motor, Used for Cutting Coal.

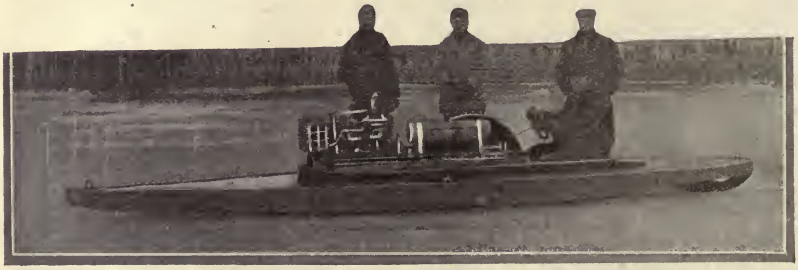
The mining machine is entirely automatic in operation. It advances by a simple hydraulic feed mechanism that propels it along the floor into the face of the seam. Rotary cutters on the shaft of the driving motor cut the coal much in the same manner as a circular saw cuts wood. A hose meanwhile directs a powerful stream of water against the face of the coal, all coal dust being washed away and the tools kept cool. The water laden with coal dust runs to the nearest sump and from there it is pumped to any desired destination for consumption.

MAGNETISM AND PETROLEUM

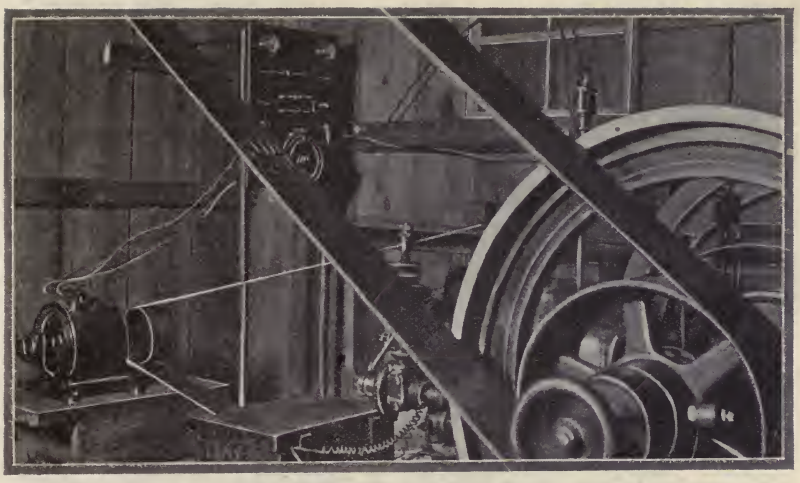
A distinguished English authority, in discussing the possibility that petroleum may be derived from carbides of iron or other metals, points out that Bauer's map of magnetic declination in the United States "proves that petroleum is intimately associated with magnetic disturbances similar to those arising from the neighborhood of minerals possessing sensible magnetic attraction," and he adds that henceforth no geological theory of petroleum will be acceptable which does not explain this association. If these conclusions are confirmed, a new and important sphere of usefulness in magnetic surveys will be opened.

BOAT THAT TRAVELS ON LAND, ICE AND WATER

An innovation in marine architecture is presented in a recently invented boat that is so constructed as to be available for water, ice and land travel. When



This Vehicle is Capable of Travel on Land, Ice or Water, Without Alterations of Any Kind.



An Electric Power Plant Employed on a Large Plantation in Texas for Furnishing Light and Power. It is Typical of Private Plants Throughout the Country.

employed on water it is operated much in the same manner as the ordinary boat, but when used on ice it is propelled by a steel wheel that digs into the slippery surface and pushes the boat forward. On land a set of wheels are brought into play and driven by suitable shafting. The four horsepower engine that is shown in the illustration performs the work of propulsion in the three spheres of usefulness.

ELECTRIC LIGHT PLANT ON PLANTATION

The employment of electricity is rapidly extending in rural districts. Not only does it furnish illumination in the farm houses and barns, but it is being employed to a greater extent each year for driving the machinery of the farm and plantation. And even where electric current is not available, small power plants are being installed to meet the demand.

In the accompanying illustration appears a typical lighting plant installed on a large plantation in Texas. The generator is connected to storage cells that accumulate current during working moments and furnish current after the plant is shut down. The current is used for illuminating the residences on the plantation, the office, and power house, and for furnishing power to a cotton gin.

OLD RIFLE CARTRIDGES FURNISH BRASS

Brass recovered from old cartridges picked up on the fields of the many battles in Mexico during the past year, is a business that is tempting many junk men. Tons of the scrap ammunition have been recovered around Zacatecas and Torreon. While most of the scrap is being sent to Mexican foundries, a considerable volume has been shipped to American destinations via El Paso.

The business, while considered lucrative, has its dangers, and in Mexican foundries where brass has been secured from spent ammunition, numerous accidents have occurred. In a foundry at Torreon the explosion of a cap in a supposed old cannon cartridge resulted in the loss of an eye to an employee.

The illustration shows a half ton of the material in a foundry located at Torreon. The large shells are heavy field cannon charges about 3 inches in diameter. The

A Batch of Spent Cartridge Shells Gathered on a Mexican Battlefield, Ready to be Melted at a Foundry.

smaller ones are mostly cartridges from Mauser guns. The shrapnel in the center is fully intact and with its brass point it represents a lucky find.

The waste of ammunition in some battles will be appreciated when one takes a trip through some Mexican brass foundry and sees tons of this material. In a number of locations where brass foundries exist, the Revolutionists took charge of the equipment and secured brass enough from this source to aid in making ammunition for their cannons. The brass gathered from this source is not used alone, but is made up with other material. Empty Mauser cartridges run about 93 to the kilogramme, or 93,000 to the metric ton.

GERMAN SUBSTITUTE FOR RUBBER

German chemists have worked out what they claim to be a practicable substitute for India rubber. They use as a basis the oil of the soja bean. Two parts of this oil are treated with one part of nitric acid, and the result is an emulsion. This emulsion is heated to the boiling-point of water, when it becomes converted into a uniform, gummy mass. Upon being washed in water, this mass is dissolved into dilute ammonia water (five per cent.), and from this solution a precipitate is obtained by neutralizing with some dilute acid. This precipitate is again washed with water and heated to about 112 degrees Fahrenheit. The final product is an elastic substance very similar to India rubber and is capable of being vulcanized.

USES OF FELDSPAR

The exploitation of the many feldspar deposits of the United States is all the time increasing, owing to the extensive use of this mineral in the manufacture of pottery, enamelware, enamel brick and electric ware. It is also used for binding together the materials of emery or carborundum wheels as well as to some extent in the manufacture of opalescent glass and artificial teeth. It is also useful in the preparation of scouring soaps and window-washes, because being slightly softer than glass, it is not liable, like the quartz contained in some soaps, to abrade the surface. Feldspar employed in pottery must be nearly free from iron-bearing minerals.

DRAWS TRADE WITH RAILROAD SIGNAL

The semaphore that is used as a stop signal for railroads was initiated in the device of a Californian storekeeper who placed a small electric model before his door. The arm reading "STOP" operated by a small motor, and colored lights, red and green, flashed as the arm moved up and down. Curiosity over the novelty brought many customers.

A Clever Scheme for Attracting Trade.

FIRE ESCAPE OF NEW DESIGN

Peter Vescoci startled noonday crowds in Indianapolis when he let himself down to the side walk from the thirteenth story of the Odd Fellows' building to demonstrate a new kind of fire escape. He made the descent without any trouble.

The fire escape consists of a steel tape of sufficient tensile strength to support more than the weight of a heavy person, which unwinds from a reel as one descends. The person using the fire escape sits in a saddle made by two heavy straps, one of which passes between the legs and the other around the waist. The speed of the descent is controlled by a lever on the reel. The tape is fastened to the window sill by means of a steel hook. The reel is small and light, and may easily be carried about by firemen or building inspectors as a part of their equipment.

Consisting of a Steel Tape Wound on a Suitable Reel, this New Fire Escape Can be Readily Carried About and Instantly Used.

GOLD MINING IN THE HEART OF A CITY

The business of gold mining has been so long associated with the wilderness that mining for gold in the heart of a city is rather exceptional. In the city of Edmonton, Northern Canada, however, since the outbreak of war, placer mining on the banks of the Saskatchewan River, which runs through the main portion of the place, has been taken up by large numbers of men. The bars of the Saskatchewan River were worked at various times in the last fifty years and as late as the year 1900 men washed from three to ten dollars a day. Of recent years, however, work on the rivers

A Miner's Equipment for Mining Gold Along the Banks of the Saskatchewan River.

bars has been given up. With the outbreak of war and the possibilities of slack times throwing men out of employment, the city council suddenly remembered the possibilities of the mining industry which offered returns right in their midst. A large number of old mining men who had settled in Edmonton after the Klondike rush of '98, offered to act as instructors in the mining of gold from the river bed. The precious metal here obtainable is a fine flour gold and has to be separated from the earth and stones by being put through a "grizzly." The "grizzly" is a wooden contrivance containing in its makeup a sluice box and riffles on a smaller scale than those used in mining coarser gold. A number of these "grizzlies," made out of a few pieces of lumber, some wire bars and a piece of blanket, were built by the veteran mining men and instructions given to those who were willing to go to work on the river. As a result some two hundred men are now mining within sight and sound of the city's main streets. One miner recently weighed in a seventy-five-dollar poke of gold as a result of a week's work. The average, however, is from one to three dollars per day.

PRESCRIPTION ON THE WALLS

Directions for keeping healthy and for avoiding tuberculosis are placed on the walls and billboards in many parts of the United States. These free prescriptions are in the form of eight-foot posters and are carefully prepared by physicians of repute who are endeavoring to stamp out consumption by an educational campaign. About a dozen designs are used, each with a brief direction and a picture to make its argument more comprehensive. Funds for the work are also secured by appeals on billboards, and every Christmas thousands of dollars for use in extending this educational work are secured through the sale of special poster stamps that are familiar to everyone.

Posters of the Kind Illustrated are Proving Effective Agents in the War Against Consumption.

WHEN WILL THE SEA BE MADE SAFE?

By Walter S. Hiatt.

IF an ounce of prevention is worth a pound on land, it is worth a ton on water.

A hundred years of progress on the sea—sail, steam, speed, and safety—have not yet produced more than comparative safety. The steamship *Titanic* was described as the acme of sea safety, and yet since that fateful night of April 14, 1912, there have been more notable sea disasters than at any other period of the world's history, barring ships destroyed in war time. Not a week passes but the sea takes a huge toll in life and property. Five hundred thousand dollars in money and 7,500 lives has become the average annual loss.

Therefore, never before have there been so many and varied efforts to rob the sea of its dangers; never so many mechanical inventions applied to this end. The big floating cities that are the larger liners, with their 5,000 passengers and fifteen millions of dollars in values, must be protected at any cost. Consequently their bridges and their decks and their masts are being armed with electric searchlights, electric devices for launching boats, gyroscope compasses, double masthead lookouts, new fire-fighting devices, motor life boats, various underwater signalling apparatus and expensive wireless sets. Every human and mechanical equipment of promise is being adopted. More officers are in charge of ships, the United States has established an ice patrol in the Atlantic, and international regulations for the navigation of ships have been fixed. Many of the larger ships have been fitted with double skins, or bodies, in addition to the water-tight compartments which should prevent sinking in case of collision. Previous to her maiden voyage last spring the *Vaterland* was even taken out to sea, her seacocks opened and water let flow in until she was one third filled, this daring test being made to find out if her steel compartments would hold in an actual collision.

But has the last word been spoken in sea safety devices?

Fire and collision are the two great modern hazards of the sea, and no finite mind can foresee when a combination of causes will produce one or the other of these dangers. For instance, the collision in 1912 of the United States cruiser *Colorado* and the steamer *Cleveland* in the harbor of Honolulu came because the pilot of the *Cleveland* was stricken and died on her bridge. No invention

Above: The Wireless Room of the S. S. "Imperator". Three Different Sets are Used on this Steamer, an Emergency Set, Short Distance Set, and Long Distance Set.

At the Left: The Gyro Compass of the "Imperator". Above: Special Telephone Apparatus that Places Officers in Touch with the Crew in all Parts of the Ship.

of mechanics could avail in such event.

Nor can invention avail when natural laws conspire to lead ships to their doom. Thus, lately, the giant *Olympic* and the smaller *Philadelphia* passed each other in broad day a few hundred miles out of New York. The ships were so close that the voice of a man shouting on either could have been heard on the other. The *Philadelphia* saluted her sister by blowing her whistle three times. The *Olympic* answered the salute. The bridge officer of the *Philadelphia* saw the steam swarming from the *Olympic's* whistle. Yet he heard no sound. Why? Because his vessel was in a sound vacuum. Sound at sea does not travel on level surfaces, but skips like a rock on a pond. Had it been a dark or foggy night, a collision might have occurred. When the *Empress of Ireland* was rammed and sunk lately by the *Storstad* in the St. Lawrence River, because of a confusion of signals, one or the other vessel may have been in such a sound vacuum.

The ratio of the fire to the collision hazard is as one to three. Fires at sea annually destroy a hundred millions in property. The word "fire" accounts for many of the mysteries of lost ships. Only in the last few months has adequate fire protection been found for ships. The old way was to fight a fire with a water hose on deck and the steam pipe in the hold. But a hold fire is tenacious because it may be discovered late and because it is impossible to reach it directly, as was the case with the *Volturno,* burnt a year ago. Steam not only dampens and ruins the cargo, but it feeds oxygen to the flame.

So when the big *Imperator* was nearly burned at her dock in Hoboken, N. J., a year ago, her owners set to work to permanently reduce the fire hazard. The result was the rebuilding of the ship until she is now practically fireproof. Automatic water sprinklers were placed throughout her superstructure, the steam pipes were replaced by carbonic acid gas pipes leading to every hold from the bridge so that

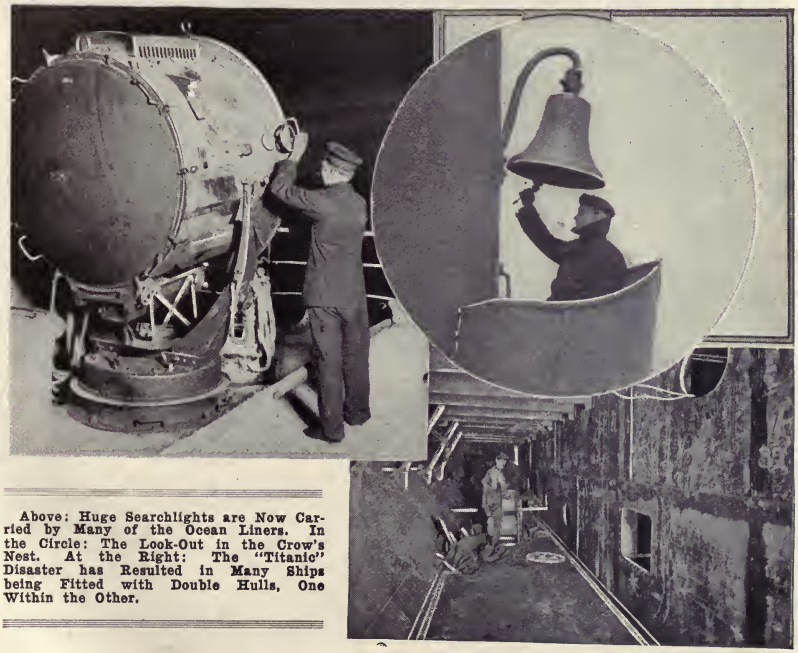
gas could be pumped therein to smother the fire. In addition, an automatic fire alarm system was put in operation and a dozen trained firemen placed in charge of all fire work. When cotton and other cargo ships adopt the gas system, then the fire demon will have been reasonably conquered at sea.

The inventions to prevent collisions are legion, as here is involved the navigation of the ship. None of them seems sure. Witness this July the collision of the passenger liner *Zeeland* in broad daylight on the roomy high seas with the freighter *Missouri.* Why? Nobody knows. Some claim that when two large bodies are near each other, they are irresistibly attracted to each other and hence drawn together. Officially, it was explained that the helm of the *Missouri* refused to obey her helmsman. It was under like circumstances that the *Republic* was sunk by an Italian ship in the Atlantic some years ago.

With ships becoming more numerous, the danger of collision is greater. A round 100,000 number will cover all the vessels above fifty tons in the world, including those for war and pleasure and commerce. But the majority of these vessels are always on the move. There are 500,000 different voyages made in the North Atlantic alone in a given year. The lights of a half dozen vessels were in sight when the *Titanic* sunk. On a dark night these vessels are invisible one to the other. Hence the value of wireless, of searchlights, of underwater signals, and double lookouts.

The ice patrol maintained in the North Atlantic not only warns ships by wireless of the presence of bad ice, but it also destroys the derelicts which the Gulf Stream carries into the ship lanes. This coming winter will see the first international ice patrol maintained there.

In case a vessel is in collision, then, she may call aid by wireless. If she has a



Above: Huge Searchlights are Now Carried by Many of the Ocean Liners. In the Circle: The Look-Out in the Crow's Nest. At the Right: The "Titanic" Disaster has Resulted in Many Ships being Fitted with Double Hulls, One Within the Other.

A Power Life Boat of the Steamer "Aquitania", Fitted with Every Requisite for Spending Several Days at Sea in Case of Disaster to the Mother Ship.

double skin and transverse bulkheads, it is not likely she will sink. If she does sink before aid comes, then she has a number of carefully equipped lifeboats to which crew and passengers can go. These lifeboats are much better equipped than a few years ago. Several of the larger ships even have big motor boats, fitted with wireless, that can scour the seas for aid or else tow the oared boats. The launching of these boats has never been an easy task in a high sea, but the crews are now compelled by law to exercise when in port, and the launching has become a much simpler matter.

All in all the man who can invent a combination of devices that will definitely make the sea safe will not only reap a reward in fortune but also in lasting honor.

ILLUMINATING OIL FROM NUTS

From the Philippines comes the report of an oil bearing nut of commercial value, primarily in manufacturing, but also as an illuminating oil. Tradition shows that before the advent of petroleum the natives of the islands used the oil from the *Amoora* as a luminant. Since the importation of coal oil the vegetable oil has fallen into disuse, and the only traces of its use are the old implements with which it was manufactured, still in the possession of the older inhabitants.

The nut comes from a large tree bearing brown, pear-shaped fruit, the kernels, or seeds, bearing over 45 per cent. oil. The method of extraction is simply one of drying, grating and pressing, the resulting oil being thick and dark.

As the oil does not dry well it is not adapted for use with paints, but in the

manufacture of soaps it is an excellent substitute for cocoanut oil. Extensive experiments are being conducted with the oil for illuminating purposes by the Philippine Bureau of Science. The abundance of the seed promises a valuable and paying industry for the islands in case the further experiments bear out the results of those already made.

USING COMPRESSED AIR FOR LINING TUNNELS WITH CONCRETE

All tunnel linings in the recent waterworks improvements at St. Louis, Mo., were placed by the new compressed air or pneumatic system that deposits a stream of concrete behind mounted steel forms.

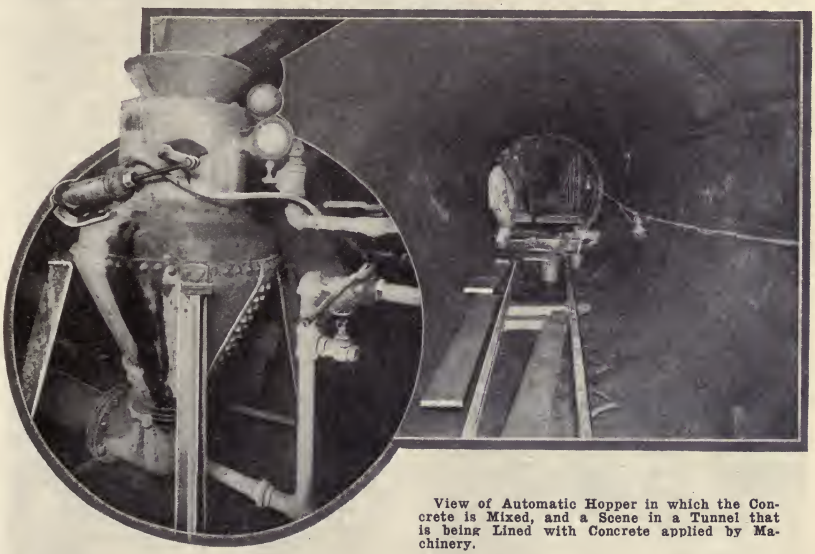
The system consists briefly of the following: A portable mold 36 feet long is mounted on a steel platform. At its sides angle pieces are bent upwards to support the crown. Its sides or "wings" can be turned or swung in by special arrangement, while the upper part of the form may be lowered by means of jacks underneath the platform. This design permits of readily changing the position of the mold as the work of lining a tunnel progresses.

A suspended pipe feeds concrete into the form and it is applied in varying thicknesses according to the requirements. Stone for the concrete is furnished at the top of the shaft while the water is supplied through a suitable piping.

On work where a considerable length of tunnel is to be lined, two forms are employed in order to reduce the length of time required.

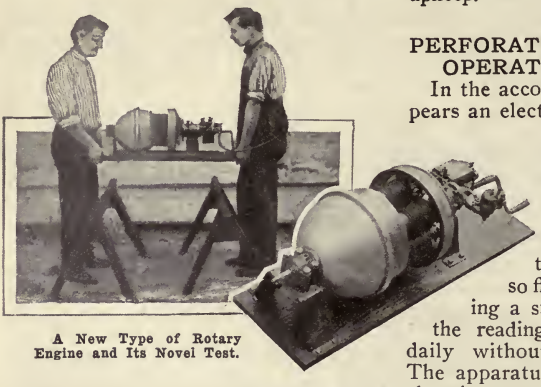
INTERESTING TEST FOR VIBRATION

In order to show clearly how little vibration resulted from the operation of a gas engine, the machine was photographed while two men were holding it, the engine making 2,500 r. p. m., during the exposure of the plate. The fogged appearance of the left side of the photograph is due to the smoke issuing from the cylinders. The slightness of the vibration is shown by the clear detail in the



View of Automatic Hopper in which the Concrete is Mixed, and a Scene in a Tunnel that is being Lined with Concrete applied by Machinery.

picture, although the engine was held in the hands while running at this great speed. Incidentally the lightness of the engine is indicated, for while it develops 12 h. p. its weight is only 115 pounds. This is a five-cylinder rotary engine of the Macomber type, which is characterized by extreme simplicity of design. The view of the engine at rest shows its very compact form. Practically the entire engine revolves when it is in operation, and the motion helps both the air-cooling process and the lubrication which is arranged to take advantage of the centrifugal force. The flywheel is eliminated from this machine, together with many other parts essential to the reciprocating type of gas engine. The wiring, for instance, is reduced to 12 inches instead of many feet; the radiator, water pump, hose connections, etc., are done away with completely and the result is the reduction of both the first cost and upkeep.



A New Type of Rotary Engine and Its Novel Test.

PERFORATED PAPER ROLLS OPERATE ELECTRIC SIGN

In the accompanying illustration appears an electric sign of new and original design. The lettering on the sign is controlled and operated by a perforated paper roll similar to that used on a player piano. It is said that the sign mechanism is so flexible that, without changing a single electrical connection, the reading matter may be altered daily without the slightest trouble. The apparatus is operated by a small electric motor.

Absolute control is one of the prime features of this motograph sign. The mechanism is so arranged that from one to sixty words per minute can be flashed on the bulletin panel. The reading matter is introduced on the bulletin panel from the extreme right and disappears at the extreme left. By making certain perforations in the paper roll, trade marks can be shown as easily as regular lettering.

The sign shown in the illustration is now in use in Seattle, Wash., on a tall office building in the business section of that thriving city.

Perforated Paper Rolls Serve to Change the Lettering on This Attractive Electric Sign. From One to Sixty Words per Minute can be Flashed on the Bulletin Board.

Hobgoblins of the Insect World

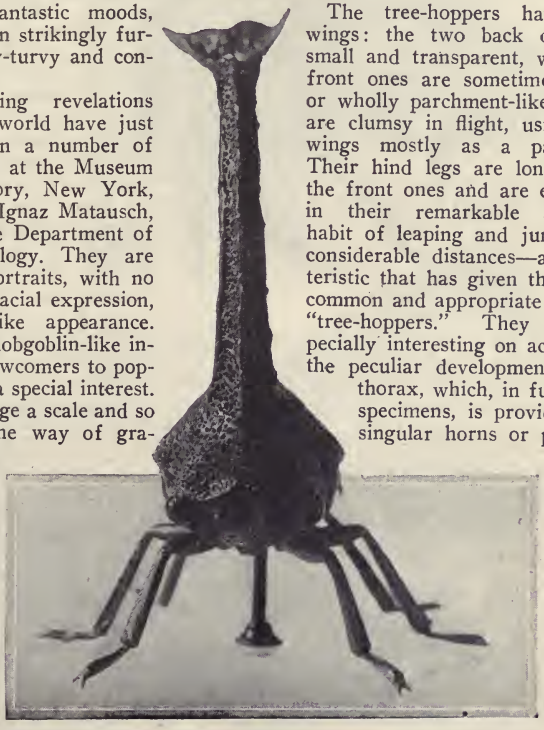
By Herbert Beardsley

AMONG the grotesque and remarkable creations of the insect world probably the least known are the peculiar and extraordinary formed creatures known as Tree-Hoppers. These bizarre and eccentric appearing little individuals, which fill one with amazement, are not apparitions from fairy land, but realities from Nature's inexhaustible treasure house of wonders. In the accompanying views a few realistic glimpses of these little known and curious shaped insects are shown for the first time to clear advantage. Nature has evidently devised and equipped them in one of her most rollicking and fantastic moods, for they have been strikingly furnished with topsy-turvy and contortionate bodies.

These surprising revelations from the insect world have just been portrayed in a number of large wax models at the Museum of Natural History, New York, executed by Mr. Ignaz Matausch, Preparator of the Department of Invertebrate Zoölogy. They are true magnified portraits, with no exaggeration of facial expression, shape, or life-like appearance. These droll and hobgoblin-like insects, veritable newcomers to popular eyes, are of a special interest. Nothing on so large a scale and so satisfactory in the way of graphically portraying the unsuspected and hidden wonders of form structure possessed by these tiny fantastic creatures, has hitherto been attempted in entomological work.

The tree-hoppers have sucking mouthpieces and live on the juice or sap of small trees and plants, which they extract from the stems by means of their sharp beaks that consist of several bristles inclosed in a fleshy jointed sheath. They are tiny, varying in size up to that of a lady bug. The tropical living types are gorgeously colored in many hues. They have four eyes: two large and protruding ones and two below, partly developed. Their two large eyes have a keen, droll look and the line that separates the head, in some instances, gives them the appearance of wearing spectacles.

The tree-hoppers have four wings: the two back ones are small and transparent, while the front ones are sometimes partly or wholly parchment-like. Some are clumsy in flight, using their wings mostly as a parachute. Their hind legs are longer than the front ones and are employed in their remarkable acrobatic habit of leaping and jumping to considerable distances—a characteristic that has given them their common and appropriate name of "tree-hoppers." They are especially interesting on account of the peculiar development of the thorax, which, in full-grown specimens, is provided with singular horns or protuber-



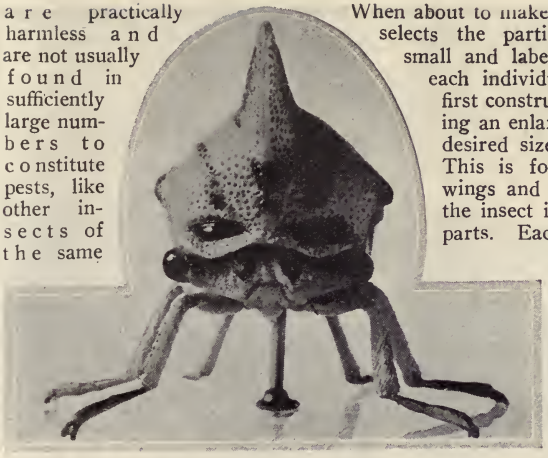
Front View of a Tree Hopper Model Made in Wax.

Two Wax Models of Tree Hoppers. These Species are Perhaps the Most Interesting of the Tree Hopper Family.

ances. These horns are often so freakish and extravagantly shaped that entomologists have hitherto been unable to account for their development and form. They remind one of some of the highly specialized horns and tusks of fossil reptiles and mammals. It is difficult to conceive of their being used by the insect in any way. These peculiar developments in structure are not so clearly seen in tree-hoppers of temperate regions as they are in the species from the tropics of South and Central America, where they are often most surprisingly shaped and surpass anything known by their strange appearance.

Many of the tree-hoppers have mountain-like humps on their backs, the pro-thorax is prolonged backward, as a roof, over the body, often quite covering the entire insect. In some instances, the pro-thorax is an elevated night-cap, in others it is shaped like a Tam O'Shanter, and sometimes it has long horns, one on each side. Some possess a wonderful sword or blade-like appendage, having ball-like projections, which often are several times the size of the body and covered with long hairs. The little tree-hoppers

are practically harmless and are not usually found in sufficiently large numbers to constitute pests, like other insects of the same order. Nearly all of the best specimens are obtained from various tropical parts of South and Central America, Mexico and India. The trapping of these hopping and wiry creatures, whose presence none but the experienced native collector can detect, is difficult, since many render themselves inconspicuous, owing to their small size, so as to escape detection and vigilance.



Front View of a Tree Hopper, showing the Eyes and Mouth.

One of the most extraordinary and fantastically shaped tree-hopper comes from Sikim, India, and is distinguished by a long, curved, tusk-like continuation of the pro-thorax, extending the full length of the body. Probably the most wonderful and mysteriously shaped of all is the specimen from Brazil, with its long, dagger-like blade and four large spindle-shaped balls, two having long, pointed projections. For a droll and comic look with imitation spectacles, the Arizona specimen is decidedly amusing and unique.

The construction of the wax models of the tree-hoppers requires most patient, skillful drawing, painting and modeling

When about to make a model, the preparator selects the particular specimen from a small and labelled wooden box, where each individual insect is kept. The first constructive step is that of making an enlarged scale drawing of the desired size of the intended model. This is followed by removing the wings and legs. Then the body of the insect is divided or split in two parts. Each of these separate dissected parts is measured, drawn to certain dimensions, and afterward worked up in clay to correct proportions, from which model plaster casts are made. These rough casts are next cleaned and assembled, forming only the general outline and crude exterior of the insect. This is followed by an application of the plastic material, a special wax preparation, which is worked up and modeled to the finest detail so that in measurement and shape it corresponds in every point with the finished sketch. The final process is that of painting.

A Species of Tree Hopper that has a Helmet-Shaped Body.

Home of a Settler in the Remotest Section of Southern Idaho, in which Extensive use is made of Electricity.

ELECTRICITY IN REMOTE DISTRICTS

It is surprising to notice the progressive spirit displayed by some settlers even in the most remote rural districts. In southern Idaho may be found numerous settlers who are employing electricity to light and heat their homes. The accompanying illustration is a typical home of a settler who employs electricity for heating and lighting, as well as for cooking. It is said by visitors to this house that the electrical equipment is quite up-to-date. In fact, there are few farms, or even city houses for that matter, so completely equipped. The Government is supplying power at reasonable rates and the settlers are not slow to realize its advantages.

ELECTRICITY TO BANISH ARCTIC NIGHT

The long gloom of the far north will soon be brightened by electricity. The shadows that have haunted the Arctic Circle for ages will be driven away by the blaze of twentieth century invention. Arc light will banish arctic night. All this, if the plans of the Right Rev. Peter Trimble Rowe, Protestant Episcopal Bishop of Alaska, do not go amiss.

Bishop Rowe returned to civilization, warmth and light last autumn with a deep-rooted conviction that it was time for man to get busy in the frozen north and turn on the electric lights. This conviction he confided to his brethren at the General Convention in New York, but his confidence was rewarded with a more or less audible titter. This snicker was subdued into a very respectful silence, however, when the prelate added that he had already arranged to supply electric light for Point Hope, one of the centres of the missions he has established in the Alaskan territory.

Point Hope, which for a considerable portion of the year is in continuous darkness, will soon have an electric plant. Already, Dr. J. W. Temple, of the engineering department of the University of Pennsylvania, is at work on the design, and Mr. Temple will personally supervise its construction.

The great windstorms which sweep all through the long winter night along the bleak Alaskan coast will be harnessed by windmills and made to produce the power. A certain amount of power, as well as light, will probably be generated.

ELECTRICAL WELDING OF STREET CAR RAILS

The man with the mask is melting a stick of the hardest kind of Bessemer steel down into the crack formed by the ends of the steel rails of manganese steel. He is employing the electric current secured from the overhead trolley wire and the rail. As the steel rod he holds is brought in contact with the rail, the ed by the intense heat of the current, at the rate of two inches a minute. As a result the two grades of steel in the rail and melted rod are combined together in a perfect weld. The rail is then ground off to smooth the joint former is melt- and the work is complete. The man wears a pair of heavy rubber gloves and dry shoes to prevent the 500-volt, 300-ampere current from passing through his arms and body to the ground. In order to protect his eyes, the man wears a mask fitted with orange-colored glass windows.

Workman Using an Electric Arc for Welding Street Car Rails.

It is said that rails may be welded by this process in less than five minutes and without the necessity of tearing up the pavement around the rails and stopping traffic. Hundreds of miles of street car rails in Cincinnati are being welded together by this simple process.

A Russian naval officer has just invented an electrically-operated machine for writing messages in cipher code, as well as deciphering the messages when they are received.

MISSOURI'S HIDDEN LAKE

This curious body of water lies in the heart of the Ozark Mountains. In Oregon County, Missouri, and Fulton County, Arkansas, are grouped Grand Gulf, Mammoth Spring and Spring River. Grand Gulf is the most extraordinary of the three. The shallow streams, about one-fourth of a mile distant from one another, flowing in the same direction over an elevated plateau, suddenly drop into cañons nearly five hundred feet deep. These two cañons form a junction half a mile below where they strike a mountain lying directly across their path. Now this mountain has been tunneled by the action of the water, and the natural bridge thus formed is no less a curiosity than the natural bridges of Virginia and Utah. It is almost equal to the former in size, while comparing favorably to both in point of beauty.

After passing through this mountain the united streams strike another mountain and tunnel it for several hundred feet. Then they spread out into an immense underground lake, the area of which is not exactly known. Many persons have entered the tunnel, but for the most part it is quite a mystery. No light can long exist over the bosom of this lake, which is a kind of reservoir that supplies Mammoth Spring with its sixty thousand cubic feet of water every minute.

The above Ornamental Object, as well as those appearing on the Opposite Page, have been Forged in Iron by an Expert Blacksmith. The Ordinary Tools found in a Blacksmith's Shop have been Employed in Making the Objects.

An American Wizard of the Forge

By Robert H. Moulton

WHEN a year or two ago someone ferreted out Louis Van Boeckel in a small hamlet in Belgium the art world wondered, for he had been making in an ordinary blacksmith shop, with crude tools, beautiful reproductions of flowers. To-day, much of his fine work is in the possession of the nobility in Belgium, and he has been awarded diplomas and medals at European exhibitions. A similar case has occurred in this country. There has been discovered recently, not more than forty minutes from the bustling, commercial centre of New York, a man whose skill in metal floriculture has been pronounced by critics to be superior even to that of the great Van Boeckel.

The American wizard of the forge is James Cran, of Plainfield, N. J., who not a great while ago was actually shoeing horses. All the beautiful pieces shown in the accompanying illustrations were actually made in his blacksmith shop. The only tools used were the ordinary hammer with cross peen, tongs of various sizes, pliers and one or two other simple implements, all of which were made by the smith himself.

Art critics who have seen his work agree that the welds are cleaner and neater than those made by Van Boeckel and that Cran has gone very much closer to nature in his work. Mr. Cran works entirely from memory, using no model. He studies his object closely, fixes it firmly in his mind and then begins work at the forge. When he began to do this kind of work he used ordinary chain iron; now he has adopted Swedish iron,

which is more elastic and malleable. Every piece illustrated was made in an ordinary forge.

It is an interesting sight to watch this smith make a rose. He first fashions the core and then forges the smaller petals, hammering out the ends flat and then placing them over an iron block containing holes of various sizes. By hammering them over these holes they are hollowed out until they resemble little spoons.

After hollowing out the four petals he grasps the iron rosebud in a pair of tongs, thrusts it into the fire and heats the stems. He takes it out of the fire and hammers the stems into a solid mass with the flat faced hammer. He forms the larger petals in the same manner and, after having thus made the complete rose, grasps it as in the beginning, with larger tongs, heats it again and finally places it, a red hot glowing mass, forming a beautiful representation of the genuine, natural flower, in a vise.

The smith then takes a device shaped somewhat like a screwdriver and opens the outermost petals first, then in a less degree the inner petals. By an artistic twist of the tweezers he gives these petals the natural looking curl. It is difficult to open out the petals without breaking them off, and to learn to do this required considerable patience and experience on the part of the smith.

It requires about 135 minutes to make a rose such as has been described. An attractive spray of leaves may be made in about half an hour.

All the different parts of the flowers are forged separately, and the veins or radial ribs of the leaves are produced by means of the cross peen of the hammer. The same instrument, when slightly tilted and when the blows are directed toward the outside of the leaf, produces the serrated edge of the leaf. The piece from which the leaf is made is first held in the tongs by the stem, heated and flattened on the anvil. The centre rib in the leaf is formed by having that part lap over the anvil's edge while the artist is flattening the leaf.

A rose branch thirteen inches high and made of ninety-four separate pieces, which required thirteen hours to make, excites the admiration of all who see it.

Mr. Cran began his apprenticeship as a blacksmith in Scotland when 18 years of age. But horse-shoeing, repairing plows, harrows and wagons grew monotonous after a few years, and Cran, in looking for something new in blacksmithing, had the good fortune to get employment from Mr. James Anderson, the famous maker of iron golf club heads, of Anstruther, Scotland. At this kind of work he soon became an expert and was successively employed by several of the best-known manufacturers of golf irons in Scotland.

In 1896 he came to the United States and was probably the first man to make a hand forged golf club in this country.

After a few years devoted to this work, he started out to follow machine blacksmithing, and to-day superintends the most intricate and exact work in forging the fine products of one of the largest machine tool concerns in the country.

It is in his leisure hours that he himself works at a small forge which he has fitted up in the rear of his home, molding into everlasting beauty wreaths of flowers that defy the winter's frost.

In parts of the West where trees are scarce, sage brush is used for fuel. In Nevada the large main stems are trimmed by Indians at $3 a cord and delivered to the user at about $6.50. Sage brush burns rapidly and is rather dirty, but produces good heat.

Those familiar with the eastern mistletoe only have no idea of the great losses due to this parasite in the forests of the West, where it counts next to fire and insects in the amount of damage done.

Virginia uses more wood for boxes and crates than any other state, followed by New York, Illinois, Massachusetts, and California, in the order named.

The Insurance of Arms

By Martin Wells

THE sudden precipitation of peaceful Europe into a trampled field of war, last August, has had the result of raising the important question in the United States as to whether the country is in any kind of shape to meet a possible aggression or enforce a just demand upon another power.

There is a great, natural advantage in the isolation of the United States, surrounded as it is on practically three sides by vast expanses of salt water and on the north by the practically unarmed colony of a friendly nation. This advantage has been dinned into the ears of the public, taught in our school books and generally accepted at a greater value than its worth; in addition, there is a strong sentiment throughout the country that when the time comes, a nation of a hundred million can surely arm and with the vastness of its numbers, eventually hurl an invader into the seas across which he came.

And upon what is this last belief founded? Upon past victories in every war in which the country has been engaged?

It is not a fair test. In all its history, the United States has never struck against the full weight of a great country. The revolution was won by the American farmers and colonists fighting only against what comparatively few troops England could spare from European fields. India held her attention; France held it and the guarding of a vast empire expanding held her forces at other points.

In the war of 1812, Wellington needed every man and every ship against the power of Bonaparte, and only a comparatively small force of the red coats marched into the United States. And yet, they took Washington and burned the capitol!

The Mexican war next engaged the armies of the country. The enemy had but a small force, poorly equipped, poorly armed and poorly led, and, as wars go, it was but a small war. Again, it is no test, the United States against Mexico.

The Spanish-American war found us opposed to the armies of a great country fast lapsing into obscurity from its past glories. And it found us grossly unprepared in men, and, what was more important, arms and munitions. Even our troops were compelled to use to a certain extent the deadly black powder which served to indicate the position of our troops to the Spanish fire. Spain was by no means a powerful foe.

To illustrate from another angle, the civil war was a great war, but it was between factions of our own people—and *neither* side was prepared. Had either the Union troops or the Confederates been ready, with ample store of weapons and equipment, despite the lack of training, that side would have been in a position to enforce its will at an early date.

Here is what lack of preparedness cost the whole country as a result of the civil war. The Union losses were 349,994 dead. Figures are not available for the other side, but it is easily safe to assume that 150,056 Confederates died in the war. These figures give a total of at least 500,000 American lives sacrificed upon the field of battle or incident to it.

At the average age of these young men who died that a united country might be firmly welded, it is safe to assume that they might have lived for twenty years—certainly that long on the average.

To be modest in our assumption, each of them would have done work to the value of at least $500 a year—very modest—a total for the twenty years they might have averaged, of $10,000 apiece. Multiply that by the 500,000 who might have lived, and the result is five billions of dollars.

In addition, the war cost the country

at least one million dollars a day to feed, clothe, arm, transport, pay, etc., the forces. This totals a little sum of $1,500,000,000. Added to the other sum, it reaches the staggering cost to the country of six and a half billion dollars, to say nothing of the distress and destruction from which part of the United States has never recovered.

Now this staggering cost was due to the fact that the Federal forces were not prepared for war. Had there been an efficient army susceptible of prompt expansion to a fair war strength, the South would have been overawed or a decisive victory early in the conflict would have ended it. Instead, it dragged along for four years, the first two being mainly given to preparing for war. At the first Bull Run it was

¶ Time was when the geographical isolation of the United States could be depended on for protection against aggressive European powers. Today, with the efficient battleships and transports in the hands of many European nations, the three thousand odd miles of ocean expanse offers but a small obstacle in the way of an invasion.

a question as to which side would run first.

But any possible foe of the country to-day is amply prepared.

The United States far tops the world to-day in wealth. It leads with one hundred and thirty billions, its next competitor, England, trailing along with eighty billions. France has sixty-five billions, Germany sixty, Russia forty, and so on down.

Our treasure house is not very well locked.

We are only supposing, of course, but let us suppose that some country, coming out of the present great war, finds itself with a magnificent army and navy and an empty treasury. And, right across the Atlantic, is the richest country in the world, practically undefended.

Could the navy stop him? The navy would get the first crack at him, for the seas must be kept clear for an enemy to maintain a line of communications for supplies and men from the home land.

The naval lessons of the European war to-day teach that ships of short range cannot compete with ones more modern. Admiral Craddock's ships plunged to the bed of the Chilean coast before the outranging of the German ships. The heavier guns enabled the Germans to keep out of the range of the English gunfire and batter their opponents almost at leisure. And the tables were turned off the Falkland Islands. Two British battle-cruisers added their weight to the lesser English ships and the German fleet was sunk by the same process—outranging.

To-day, the United States has eight dreadnaughts built and four building. A navy's strength is measured in terms of dreadnaughts, on the same principle of range and weight of gunfire. England, the leader, has twenty completed, with sixteen building; Germany, next in rank, owns thirteen built, with seven more nearing completion.

But the point is that lesser nations, possible foes, have a building programme under way which, within a comparatively short time, will relegate the United States to a lower place in the list. In lesser ships of vital importance, such as battle-cruisers, cruisers, destroyers and submarines, the navy of our country is sadly behind, as shown by the official records. And yet we have a sea coast far greater than that which any other country has to protect.

A foreign foe may not land troops in force in America until our navy is defeated. And, as dreadnaughts only count, it is seriously to be doubted if we could hold off the fleet.

If victory is denied our fleet, there

are a thousand points on the coast at which an enemy may land; say somewhere on the New England coast. The enemy would strike with the speed of lightning and it would be utterly impossible with the small regular force in the United States, augmented by the National Guard, to mobilize in time and in sufficient force to check the advance upon New York, for that city would surely be attacked from the land side.

With finance paramount in this country, it is not difficult to foresee the result of the capture of New York. From the narrow canyon of Wall street, terms of peace would be dictated—and they would probably be agreed to. And the price of peace would certainly be gold, running into the billions.

Rifles cannot be built in a day; nor field guns, equipment, air craft and the all-important ammunition. Roused by invasion, the men of the land would flock to the colors—but there would be nothing to place in their hands, because arms had not been provided beforehand.

The business man insures his life and his plant against fire. Each one would regard it as poor business to fail to do so. Yet, lulled to a false security, the American business man does not insist that the same precautions he takes individually be taken by the nation to preserve his honor, his business and his home!

There is a huge disparity between the stupendous cost of war and the cost of the relatively small insurance premium paid for preparedness—an efficient and ample navy, guns, equipment, ammunition and a trained nucleus of men, for expansion to war strength!

No man wishes war, if he has even the vaguest appreciation of its terrors, its sorrows and its awful price in blood, treasure and national humiliation for the vanquished. But the fact that it is not welcome will never prevent its coming. No one supposes that the masses of the European countries which are now plunged in war were willing that their families should be subjected to the affliction which must result to hundreds of thousands, nay, millions. And the nation is founded upon the home.

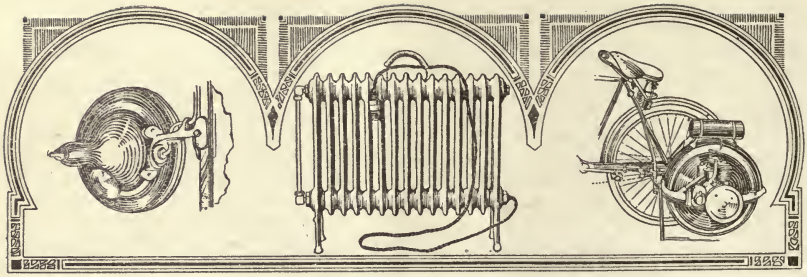
And, furthermore, no man can speak for a country, whether republic, monarchy or loose confederation. Each and every one, to give a just answer to the question, must think the matter out for himself.

War is practically unavoidable in the present scheme of world organization and policies. And, as each man nurses at least a spark of regard for the country which has borne him or is of his adoption, he is, underneath, jealous for its prestige and success. But regrets, after a defeat, are powerless to remove the sting.

¶ Military preparedness does not necessarily mean that a nation has military and conquering aspirations. Nor does it follow that a nation so prepared is more easily led into war with its neighboring powers, but quite on the contrary an efficient system of defense is no invitation for an attack.

An adequate appropriation for a navy, guns and equipment, can easily be spared—so much more easily than is the case with any other power. The correct sense of security which must result will do far more to increase prosperity by the very insurance against molestation and the ability to maintain principles of honor, than the comparatively small saving effected by an unsound niggardliness in the expenditure of national moneys, wherein an impotent force for defense is maintained. In case of defeat, the present force would be a dead loss.

Let each man think it out for himself—and act.



Mirror Searchlight. Steam-Electric Radiator. Motor Wheel for Bicycle.

Recent and Improved Devices

Mirror Searchlight

A combination of an electric searchlight and a diminishing mirror has recently been placed on the market. The device serves the double purpose of an adjustable searchlight at night and in the day time a mirror for making visible vehicles approaching from the rear. The illustration shows this device which comes equipped with all the necessary brackets and wiring attachments so that the lamp may be installed on a car in a few minutes' time. The switch is in the handle of the lamp so that the driver can turn the light on and off as desired without interfering with the other lights. The lamp can be prepared for emergency service by wiring it direct to the battery.

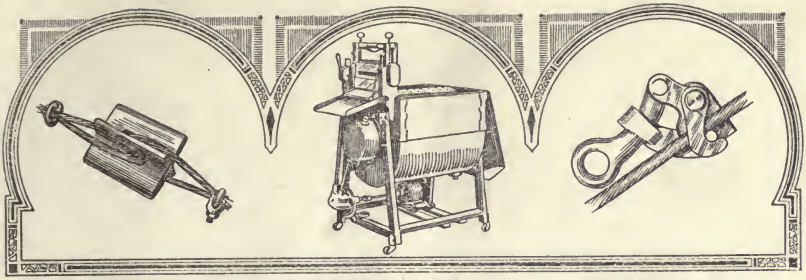
The lamp embodies many conveniences, among which may be mentioned an adjustable bracket which automatically locks at any angle desired, and a detachable back reflector so that the lamp bulb may be removed and replaced in the reflector without fingering or soiling the highly polished surface.

Steam-Electric Radiator

The electrical steam radiator is the latest contribution to the heating field. The device utilizes the heat radiating characteristics of the steam radiator and the steam is produced within the heating unit through a system which is simplicity itself. To all outward appearances, the device resembles an ordinary steam radiator. In the bottom water way of the radiator is placed a tube and within this tube is inserted another, some three-sixteenths of an inch smaller. A resistance coil, properly insulated, is inclosed within the smaller tube. In the radiator is placed a small quantity of water—from one and one-half to three quarts, according to the size of the radiator. The water reaches the inner tube containing the heating coil through an opening in the larger tube. As soon as the current is turned on, the thin film of water becomes heated and circulation commences.

Motor Wheel for Bicycle

The application of a gasoline motor to an ordinary bicycle is not new, but it is extremely doubtful if many of the attachments of this nature are of much practical value. As a rule the attachment involves some more or less serious and expensive change in the frame of the bicycle. The motor wheel illustrated herewith, on the other hand, is quite a departure from the conventional attachments of this nature as it comprises a complete power unit in itself and re-



Porcelain Strain Insulator. New Washing Machine. Improved Come-Along.

quires no changes whatever in the frame of the bicycle for its successful attachment and use. The power plant consists of a small gasoline motor mounted in a substantial frame which is carried on a rubber tired wheel that serves as the driver. Above the wheel is mounted the gasoline tank. A glance at the illustration will show that the device is entirely self-contained and that it is attached quite easily by means of clamps to the framework of the bicycle, of which, however, it is quite independent.

Porcelain Strain Insulator

A porcelain strain insulator that is said to be very good for antenna work is shown in the illustration. An important feature of the insulator is found in the fact that should it break, the wire will still be supported. The design is such, however, that a fracture of the insulator is highly improbable and its mechanical strength is of a high order. Another important feature is the extremely low electrostatic capacity of the insulator. It is made in three sizes, 3½. 5 and 6½ inches in length.

New Washing Machine

The aim in designing the electrically driven washing machine shown in the illustration was to insure absolute safety even to the most careless operator. There are no chains or belts to catch the fingers or clothes and every moving part is enclosed. The wringer is so arranged that it is impossible to get the fingers caught in the rolls, thus making accidents from this source impossible.

The machine is driven by a small motor which can run both washer and wringer at the same time. Two switches, one for the washer and the other for the wringer, control the operation of the machine.

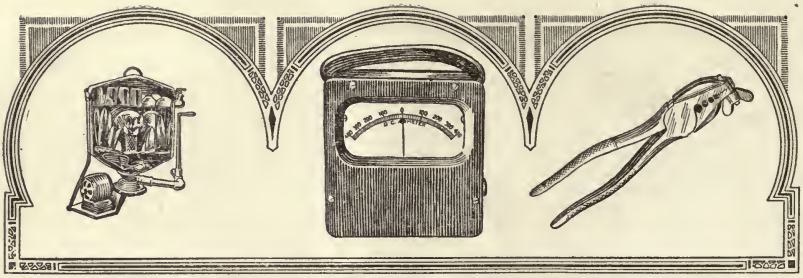
Ordinarily, the body of the machine is made of galvanized steel and the cylinder of maple, but if desired a copper body and cylinder can also be furnished. A special feature of the design is the limitation of the width so that the machine will pass through a 25-inch door.

Improved Come-Along

A new type of come-along or cable clamp has recently made its appearance on the market. This clamp presents several features of interest, among which is the fact that it can handle cable up to ¾ inch in diameter; in fact, the device is said to be the outgrowth of a demand for a clamp to accommodate a cable larger than ½ inch in diameter.

The body and handle of the clamp are of steel forging and the eccentric is of hardened tool steel. The most interesting feature of the construction is the addition of a swing latch which engages with the stud on the lower jaw, thus centralizing the pressure on the cross bolt which is made of turned steel of great strength.

A solution of ammonia and alcohol will serve to remove lacquer or varnish from metal.



Motor Driven Dishwasher. Cable Testing Ammeter. Wire Connecting Pliers.

Motor Driven Dishwasher

It is inevitable that the motor driven dishwasher will become as important an electric utility as the washing machine or vacuum cleaner. Many women who do their own work employ others to take care of the laundry or housecleaning, but nearly all do their own dishwashing three times a day.

The illustration shows the appearance of the internal construction of a new dishwasher that is designed to relieve the housewife of this disagreeable task. The dishes are placed in wire trays, the container partly filled with hot water and soap added. At the bottom of the container is a dasher which is rotated rapidly by a small electric motor and which forces the water up between and over the dishes, washing them thoroughly in a few minutes. The dishes are not merely sprayed but are swept by solid waves of hot water. Since the trays do not move, there is no danger of breaking the dishes. The bottom of the container is conical in shape so that drainage is perfect. The washer is supplied for wall mounting as shown or for portable use. It is manufactured in three sizes for home, restaurant and hotel use.

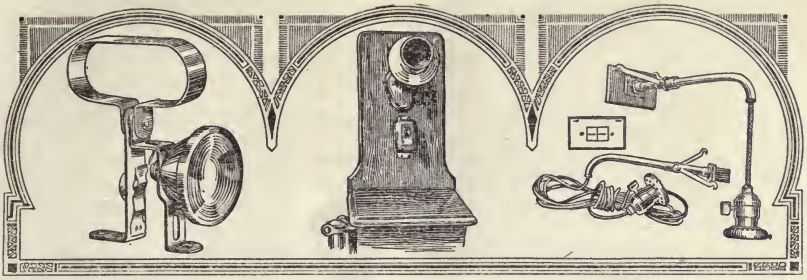
Cable Testing Ammeter

A new cable testing ammeter, designed to measure the current passing through a cable without either disturbing same or opening the circuit, has recently been introduced. This instrument, an illustration of which appears on this page, can be prepared for immediate use by removing the "U" shaped iron strap, placing the conductor within the loop of same and reinstalling the strap to the instrument terminals. When the key is pressed, the instrument will indicate the value of the current flowing in the enclosed conductor.

The instrument resembles in principle those of the D'Arsonval type excepting that the permanent magnet is displaced by the detachable iron loop and the moving coil circuit is energized by a small auxiliary battery. It will readily be seen that when the iron loop encloses a conductor carrying current, the flux in the magnetic circuit of the instrument will be proportional to the current flowing in the conductor and as the moving coil is energized by a separate current of constant value, the deflections of the pointer on the scale will be proportional to the current flowing in the enclosed conductor.

Wire Connecting Pliers

An interesting contribution to the field of electricians' tools is seen in the novel wire connector illustrated on this page. It will be noted that the connector resembles a pair of ordinary pliers of substantial design with the addition of a wing nut on a swivel bolt at the nose of the tool to hold the jaws tightly together after the twisted joint of wire has been inserted. This feature makes it necessary to use only one hand in gripping the wire even though it be of steel and quite heavy. In fact,



Hand Lamp Attachment. Measured Service Meter for Telephone. Ingenious Lighting Fixture.

the tool illustrated is fitted with holes to take wires of Nos. 8, 10, 12, and 14 gauge.

The connector is designed for use with any of the standard sleeve connectors so popular with linemen at the present day. Obviously it should prove a boon to the wireman and in examining the device, one is tempted to reiterate the old story, "Why has no one thought of it before?"

Hand Lamp Attachment for Dry Cell

Among the several attachments designed to convert a dry cell into a hand lantern, probably none is simpler in design and withal more effective than that illustrated herewith. The device is simplicity itself and it consists essentially of a frame and handle of metal strip so formed that it may be clamped to the top of a dry cell of standard size by means of the binding posts, thus accomplishing the double purpose of making the electrical connection and mechanical support at the same time. Attached to the frame is a reflector carrying a small tungsten lamp and a lens to direct the rays in the desired direction. A push button, also incorporated within the frame, enables the user to turn the light on and off at will.

Measured Service Meter for Telephone

As the result of several years of experimental work, the manager of an independent telephone company has produced a telephone service meter system which, in the opinion of a number of prominent telephone men, is both practical and of great merit. The device, which is intended to register the calls made from the instrument upon which it is installed, is in actual operation in a Pennsylvania city, and enables telephone subscribers to keep a check on their calls.

Ingenious Lighting Fixture

A lighting fixture intended for use in hotel sample rooms has recently been introduced on the market. The distinctive feature of the device is its portability and ease of attachment to various parts of the wall from which it is suspended on a bracket. As the illustration shows, the lamp socket is swung out from the wall at any point desired, and for its attachment the base of the supporting bracket is inserted in a wall pocket, any number of which may be located in various parts of a room. The device is very useful in the household in connection with reading lights over a bed, side table, etc.

Its most prominent use, however, is for the lighting of hotel sample rooms and its design is the result of a demand on the part of hotel managements for a ready means of properly lighting the bedrooms of hotels for the peculiar requirements of this class of work and at the same time to provide a fixture that can be removed quickly and easily without leaving any disfiguring marks on the walls of the room.

Recording a Plant's Emotions

By Basanta Koomar Roy

THROUGH the medium of the electric current a Hindu scientist has recently startled the world by proving that plants have temperaments and that in many ways they have the characteristics of human beings. The scientist, Jagadis Chunder Bose, professor in the Calentta University of India, is now lecturing before the various academies of science and in the leading American universities. Previous to this he has appeared before learned bodies in Europe.

Bose utilizes electricity to make plants express their feelings, or "speak," as it were. His researches in plant life have been classed by eminent scientists of Europe and America as something that may be favorably "compared with the works of the masters of the historic past."

Philosophy claims that life is one and that it permeates both the organic and inorganic worlds. The life in minerals, the life in plants, and the life in animals are identical. The difference is that of degree of development and expression, and not of kind. The philosophers' intuitive claim cannot always be accepted as true until science has proved it to be so. It is doubtful if any other man has proved this unity of life by accurate scientific methods to such a great extent as Dr. Bose.

The eminent plant physiologists of Europe claimed that the response in plants was not a true excitation, but was a hydro-mechanical blow. Dr. Bose has conclusively proved the fundamental unity in the response of plant and animal. And it has been done by specially invented mechanical devices that make the plant itself prove it by writing on a plate the story of its own life.

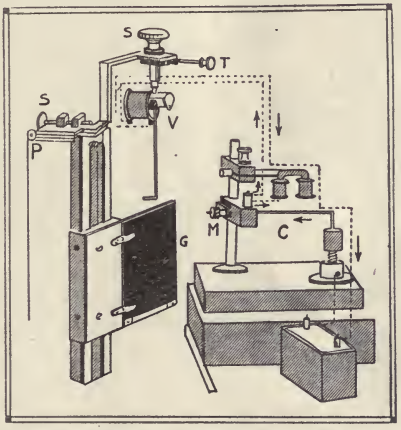
Hit an animal and it feels the pain, trap an animal and it shows its displeasure and tries to escape, drug an animal and it is affected according to the property of the drug. Do plants react under similar circumstances? No, we are sure to say. "But wait a minute," says Dr. Bose, "don't jump to conclusions. It is risky. Look here, by my machines I have made the plant exhibit many of the activities which we have been accustomed to associate only with animal life."

Dr. Bose proves his statement by means of his unique machine called the "Resonant Recorder." A description of this machine may be quoted from Dr. Bose's Friday Evening Discourse delivered at the Royal Institution in May last: "The principle of my resonant recorder depends on sympathetic vibration. If the strings of two violins are exactly tuned, then a note sounded on one will cause the other to vibrate in sympathy. We may likewise tune the vibrating writer V, with a reed C. Suppose the reed and the writer are both tuned to vibrate a hundred times per second. When the reed is sounded the writer will also begin to vibrate in sympathy. In consequence of this the writer will no longer remain in continuous contact with the recording plate, but will deliver a succession of taps a hundred times in a second. The record will therefore consist of a series of dots, the distance between one dot and the next representing one-hundredth part of a second. With other recorders it is possible to measure still shorter intervals. It will now be understood how, by the device of the resonant recorder, we not only get rid of the error due to friction, but make the record itself measure time as short as may be desired. The extraordinary delicacy of this instrument will be understood when it is noted that by its means it is possible to record a time-interval as short as the thousandth part of the duration of a single beat of the heart."

By means of the recorder a plant automatically records how it is affected by cloud or sunshine, by rain, drought or drugs. The internal story, rather the mind, of a plant can never be

studied by human vision, but it has been made visible by machines invented by human mind—the mind of a scientific man from mystic India.

Is the plant equally excitable at all hours of the day and night? When certain plants close their leaflets, it is poetically claimed that they have gone to sleep. But Dr. Bose claims that these "movements are brought about by variation of turgor and have nothing whatever to do with true sleep, for similar closure of leaflets takes place under precisely opposite condition of strong light." But by taking automatic records of its daily diary, the sleeping hours of the plants have been detected by Dr. Bose. Speaking before the Columbia University in early December, 1914, Dr. Bose claimed that plants were like extremely fashionable ladies that kept very late hours at night and fell asleep at the early hours of the morning. A plant makes up for its late hours by gradually waking up by noon. It remains in a condition of uniform sensibility all the afternoon.



"Resonant Recorder" Apparatus that is Employed to Record the Emotions of Plants.

The plant, like the animal, is injuriously affected by impure air. It is a superstition to think that plants flourish in carbonic acid gas. Dr. Bose has taken records that go to prove that it is suffocated in carbonic acid gas, just as human beings are. The effect is, of course, modified in sunshine by "photosynthesis." Ozone makes the plant thrive, but renders it easily excitable. Sulphuretted hydrogen is fatally injurious to the plant. Chloroform has the same effect on the plant as on a human being. "The ludicrously unsteady gait," says Dr. Bose, "of the response of a plant under alcohol could be effectively exploited in a temperance lecture."

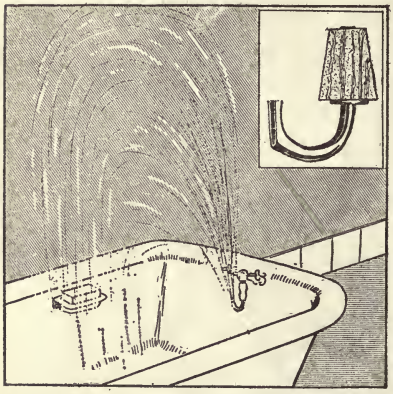
As in life, so in death, the plant shows similar signs of decreasing vitality, and then comes a moment in the life of the plant when it refuses to respond to excitation. As in man, so in the plant a spasm—the contractile spasm of death—passes through every fibre of its being. This spasm is accompanied by an electrical spasm as well. "In the script of the death recorder" (another of Dr. Bose's inventions) "the line that up to this point was being drawn, becomes suddenly reversed and then ends. This is the last answer of the plant." Thus the plant dies and long after this it begins to wither and show outward signs of death.

Thus Dr. Bose, who combines in his mental make up the ideals and the culture of both the East and West, proves the heart beats of the plant, with all its tales of joys and sorrows, of diseases, disappointments and death — conditions that affect the animal world from the cradle to the grave. The message of Dr. Bose's researches is: This world is pulsating with life—a life that is one and indivisible.

A SHOWER BATH SPRAY CARRIED IN THE VEST POCKET

A Californian named D. S. Rockwell, who makes his home in Berkeley, has been surprising his friends with a new kind of shower bath, one that may be carried in the vest pocket or in a lady's handbag. This useful and curious article is constructed of nickel-plated brass tubing and a cork. The tubing is bent something in the manner of a fish-

hook and inserted into the cork through a hole in the center, with a round plate to keep it from slipping. The tube is flattened at the end with a narrow slit about half an inch long cut in it. This slit is what causes the water to spray. Whenever the tired and dusty traveler desires to cool and refresh himself with a shower, he need not be discouraged by finding that there is no shower bath in the home he is visiting or the small-town hotel. The convenient little attachment is instantly fitted into any faucet in bath tub or lavatory, and the water turned on.

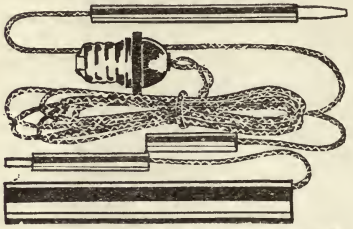


Simple Shower Bath Attachment that may be Carried in the Pocket.

A good sized spray is the result, and while not as powerful as the regular shower, it is delightful when the traveler is hot and fatigued from his journey, yet despises, as many Americans do, the tub so dear to the Englishman's heart. The cork is cut tapering to wedge into the faucet.

Handy Testing Outfit

In the accompanying illustration is shown a circuit tester of useful design. The outfit comprises an attachment plug, several feet of flexible cord, a connection case containing sockets in which plugs are inserted to form various connections, an incandescent lamp to serve as a signal, and a special contact piece in an insulated handle with which to make contact with the wire of the circuit to be tested. The incandescent bulb may also be used as a trouble lamp for



Different Parts of a Handy Circuit Tester.

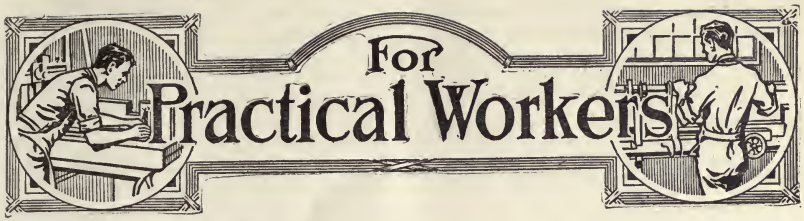
use in places that would be inaccessible to the ordinary bulb.

Battery Table Lamp

There is a large demand from rural districts where electric current is not available for battery lamps of a practical design.

A table lamp designed for use with battery current has recently been placed upon the market. The lamp comprises a standard attached to a wide, decorated base. Through the base and standard a silk covered flexible wire runs down to the battery box which holds four dry cells. The small incandescent bulb is placed within a reflector of ingenious design which concentrates the rays of light in such a way as to increase the useful candle-power of the diminutive bulb. The complete unit is especially adapted for use as a reading or shaving lamp and a swivel joint makes it possible to turn the reflector in any direction.

Table Lamp that is Operated from Dry Cells.

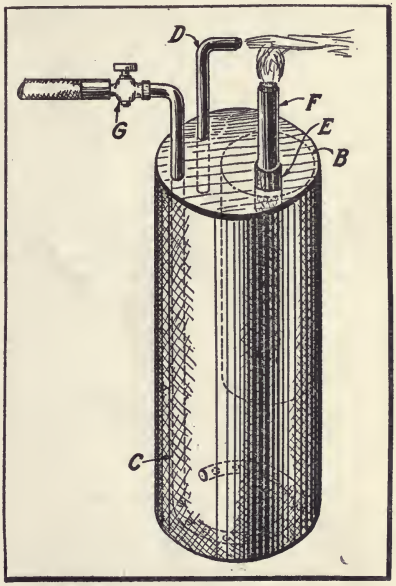


Electrician's Blow Torch

The drawing illustrates a blow torch that may be made by the amateur workman out of materials to be found in the average workshop. The torch consists essentially of a large receiver or cylinder for the air and within this cylinder a much smaller one, shown at *B* in the drawing, to hold the fuel which may be either alcohol or kerosene.

The outside cylinder is formed by rolling up a piece of sheet copper 7 x 11 inches and securing at the seam with solder. Heads of sheet copper are fitted to top and bottom. The bottom of the cylinder may be permanently closed as soon as the copper forming the wall has been bent to shape. The top of the cylinder, however, should be left open in order that the smaller cylinder *B*, together with the air inlet and outlet tubes *C* and *D*, may be fitted in place. The smaller cylinder is 2 inches in diameter and 3 inches long, closed at the bottom. The top of the small cylinder is soldered to the lid of the large cylinder after the wick holder *F* and its collar *E* have been secured in place. The collar *E* is a short piece of pipe about 1 inch in length and ¾ inch in diameter, while the piece *F* is about 3½ inches long and of a diameter that will permit it to slide through the collar *E*. The latter is soldered to the cover of the cylinder in order that the piece *F*, which carries a wick, may be removed quite readily to permit the fuel to be poured into the small cylinder. Care should be taken to see that there is no leak from the small can to the large one.

The air inlet *C* is a piece of ¼ inch copper tubing about 20 inches long and bent at one end into a circular form to add mechanical strength when it is fitted into the large cylinder, as shown by the dotted lines. After being passed through a hole in the top of the cylinder and carefully soldered in place, its upper end is to be bent to a right angle and the valve *G* screwed on the threaded end. The next operation is to insert and



fasten with solder the air jet *D* which is a piece of ¼ inch copper tubing bent to a right angle and plugged in its end with a short piece of rod of suitable diameter. A 1/32 inch hole drilled through the plug forms the jet. The torch may be completed by soldering the top of the cylinder in place.

To operate the device the fuel chamber *B* is partly filled with alcohol or

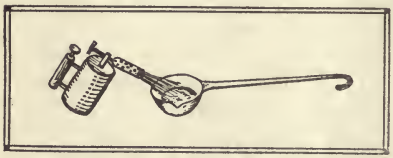
kerosene, preferably the former, the wick lighted and air pressure from the mouth applied to the rubber tubing attached to *G*. The torch will send out a hot blue flame from 2 to 4 inches in length, according to the value of the air pressure in the large cylinder.

Contributed by

CHAS. E. DIMICK.

To Melt Babbitt Quickly

If at any time the busy workman desires to melt a small quantity of babbitt, lead or other metals having a com-



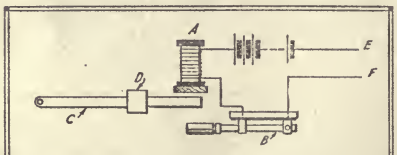
paratively low melting point, he will find that by employing the method suggested herewith, he will save both time and fuel. The amount of material it is desired to melt is placed in a ladle or other container and the flame of a gasoline torch forced directly upon the surface of the metal to be melted.

Contributed by

B. W. VERNE.

A Simple Circuit Breaker

This little circuit breaker is intended to automatically break the circuit in charging storage batteries when the



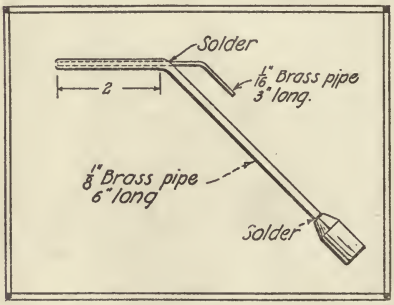
voltage of the dynamo falls below a predetermined point. The breaker consists of a small electromagnet *A* connected in series with battery, dynamo and a single pole knife switch, a pivoted bar *C* carrying a movable weight *D* and so arranged that when the proper amount of current is passing through the magnet *A*, the pivoted bar is held against the magnet. When the voltage lowers beyond a certain degree the magnet releases the bar which swings on its pivot and opens the switch *B*. By sliding the weight back and forth on the bar *C*, the breaker may be adjusted to operate on various values of current. As the magnet is placed in series with the circuit, its winding should be of comparatively coarse wire of low resistance.

Contributed by

A. H. WAYCHOFF.

A Blow Pipe

A very useful tool in the shop is the blow pipe, although this tool in its usual form is cumbersome and unwieldy for fine work. The blow pipe suggested in the present contribution has the advantage of being small and light, and it will enable the worker to direct a fine, hot



flame into places where previously only a jeweler's soldering iron could be used. The blow pipe is made entirely of small pieces of tubing that may be found in most workshops.

The first operation is to bend a 6 inch piece of 1/8 inch copper tubing to an angle of 45 degrees at a point 2 inches from one end. In the angle a hole is drilled to permit a piece of 1/16 inch brass tubing to be inserted as shown in the drawing. This small tubing may be found in a discarded gas burner of a certain type wherein it is used as a by-pass or pilot burner. The small tubing is soldered

where it passes through the angle in the large tubing and at such a point where the end of the small tubing is just within that of the large. The tip of the large tubing should be spun over to partially close the opening as the drawing indicates.

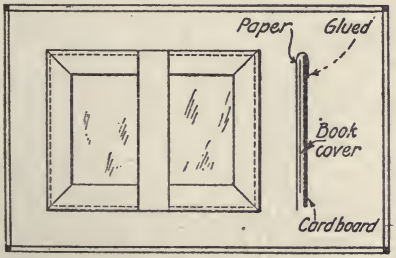
The gas supply is attached to the larger tubing by means of a rubber hose connection and the smaller tubing is likewise connected to a source of compressed air such as a sheet metal tank fed by a hand or foot bicycle pump. For the successful operation of this blow pipe a fairly good air pressure is required and the amount of air admitted to the blow pipe should be under fine control by means of a valve attached to the air tank.

Contributed by

GEORGE MENHINICK.

A Substantial Book Cover

A protecting cover for paper covered text books, such as are used by high school students, can be made by the average boy as shown in the drawing. Two pieces of heavy cardboard are cut to the size of the book cover and a piece of heavy brown wrapping paper is cut sufficiently large to entirely cover the binding of the book and permit the edges of the paper to be folded over and glued to the cardboard pieces, thus forming a double pocket. A book slipped within this cover may be used daily without having its binding soiled or stretched, and when the home-made cover becomes



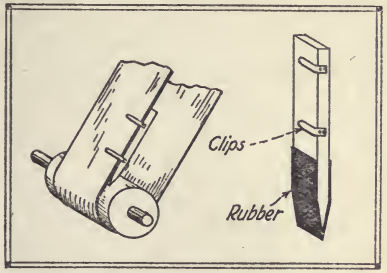
soiled a fresh one may be substituted, for it is the work of but a few minutes to make a new cover.

Contributed by

JOSEPH HATTENBERGER.

To Prevent Belt Motion

Have you ever stopped a machine in order to make some minor repairs and then had it suddenly start, either due



to the loose pulley binding or the belt lapping over on to the revolving pulley? In such a case the result is generally a bruise or a cut for the operator, and if the machine happens to be a planer the injuries may be of a severe nature.

A simple method to prevent accidents of this nature is to take a piece of hard wood about 1 foot long, 4 inches wide and 1½ inches thick, and bring one end down to a wedge shape, fastening clips on one edge and a piece of sheet rubber over the wedge-shaped end as shown in the illustration. In use the clips are slipped over the belt with the rubber-covered wedge fitting between pulley and belt. The slightest motion of the belt of course wedges the whole arrangement tightly.

Contributed by

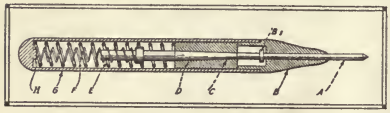
B. W. VERNE.

Automatic Prick Punch

The object of this punch is to obviate the necessity of using a hammer to make the impression. In use, the point of the punch is placed at the desired spot and by merely pressing down on the handle a blow is delivered within the latter, which forces the tip of the punch into the metal that is to be marked.

The shell of the punch *G*, is of ½ inch stubbs steel, 4 inches long and bored out to ⅜ inch inside diameter. The part shown at *H* is recessed to receive the end of the coil spring *F*. The piston or

striking punch *C* is made in two parts and is joined at B^1 with a shoulder on its upper end to receive the spring *F*. The hammer *D* is a cylinder 1 inch long which slides freely in *G*. Through the



center of the cylinder *D*, is a taper hole that engages the taper part of *C* by friction. The nose *B* is turned to fit the internal bore of the cylinder *G* and is drilled to pass the shank of the punch *A*. The action of the punch is as follows: When pressure is applied to the point *A*, the part *C* with *D* is pushed against the spring *E*, and as *D* is held on *C* by the friction of the taper joint only, it is obvious that when the pressure of the spring *E* becomes too great the hammer *D* will be released striking the shoulder B^1 with considerable force causing the point to make an indentation in the metal against which it is placed. The spring *F* serves to push the plunger *C* back to its original position.

Contributed by

JAMES MCINTYRE.

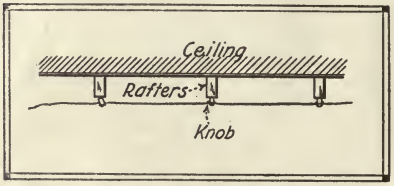
A Handy Tool Post

The tool post shown in the drawing will be found very useful, as it will enable one to use tools made from bar steel without dressing. By making linings for the tool post with different shapes of openings in them, the tools may be made from round, square, or flat stock, as the case may be. In this tool post the tool may be placed in any desired position or swung around throughout an entire circle to afford adjustments for various turning and boring operations. This tool post has been in use in the shops in which the contributor has been a foreman for a number of years, and it has proven very successful.

Contributed by W. C. DEIBERT.

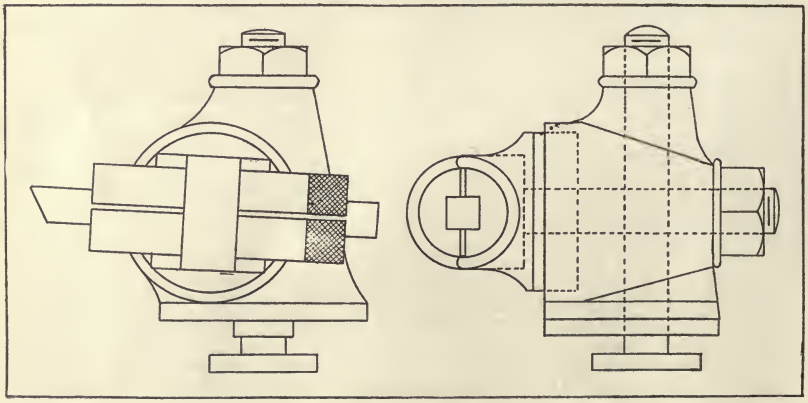
To Stretch Wires Taut

A suggestion for the wireman that may be applied while doing open work is offered in the accompanying illustration. The idea is to catch the wire on the knob, making it a trifle short of the finished distance and starting to drive the



nail at an angle. When the nail is finally driven home, it will straighten up the knob, stretching the wire tightly between rafters.

Contributed by RAE MCGEOCH.

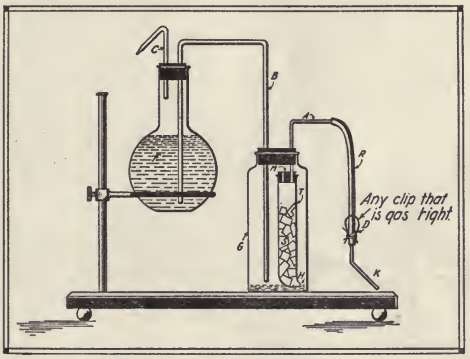


A HYDROGEN SULPHIDE GENERATOR

By E. C. Swetman

Students in advanced chemistry have frequent use for a good hydrogen sulphide generator when doing qualitative analysis. A Kipp generator is not always obtainable, and a temporarily constructed apparatus which requires attention each time the gas is used is inconvenient. The generator hereunder described supplies a stream of gas whenever desired, and ceases evolving the gas when it is not wanted.

The generator proper consists of a wide-mouthed bottle *G*, fitted with a two-hole rubber stopper. Inside the bottle is suspended, by means of the glass tube *A*, a large test tube *T*, which must be of soft glass so that a small hole may be blown in the bottom at *H* when it is held in a flame and softened. This test tube is also fitted with a two-hole rubber stopper. A florence flask *F* is supported so that the bottom is at least as high as is shown in the diagram. This flask is also fitted with a two-hole rubber stopper. A glass tube *B* connects the flask and the bottle, while a small piece of tube *C* provides an open air passage. Another glass tube *A* leads from the test tube and bottle, and is connected to some rubber tubing *R* to which is attached a clip *D* and a glass outlet *K*. All the connections about the generator must be tight so as to prevent the escape of gas. A little paraffin might be run around the connections and the large stopper to make the escape of gas impossible. A very thin coating will be found ample.



Set the generator in operation as follows: Fill the flask with dilute hydrochloric acid, leaving an air space which is connected to the outside air through *C*. Place some ferrous sulphide in the test tube and connect up the apparatus as shown in diagram. See that the clip *D* is open and apply pressure at *C* so that the acid will flow into the bottle. Once started, the acid will continue to flow on the siphon principle. As the acid fills the bottle, creeping up around the ferrous sulphide to which it gains access through the hole *H*, hydrogen sulphide is generated and forces the air from the bottle through the outlet *A*. When the gas itself is indicated at *K*, close the clip *D*, which prevents further escape of hydrogen sulphide. The gas continues to be evolved in *T*, increasing the pressure in the bottle, and driving back the acid through *B* into the florence flask, until the acid is no longer in contact with the ferrous sulphide. Then the evolution ceases till the clip *D* is opened again, relieving the pressure in the generator and allowing the acid to siphon over and come into contact with the ferrous sulphide, generating more hydrogen sulphide gas.

To insure the proper working of the apparatus, a small space should be left at *M* between the rubber stoppers. Also the test tube should not come closer than ½ inch from the bottom of the bottle. This is to allow for any gas that may be generated after the surface of the acid has left the ferrous sulphide, as otherwise some gas might be forced over through *B*, thus disturbing the siphon action the next time gas would be required.

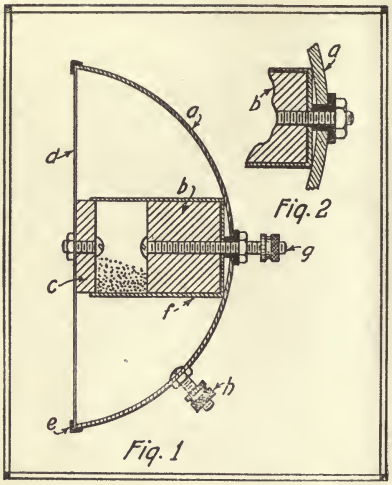


Fig. 1

Fig. 2

A Home-made Telephone Transmitter

A telephone transmitter of simple but effective design is suggested in the drawing. The materials needed for its construction are: The gong from an old electric bell, two round carbon buttons obtained by slicing off a round battery carbon by means of a hack saw, three battery binding posts and a piece of thin tin large enough to cover the open end of the bell.

A hole is drilled in the carbon button, *b*, large enough to insert one of the binding posts. A piece of paper is put on the back of the button to insulate it from the bell. The binding post *g* is also insulated from the bell as shown in the enlarged view, Fig. 2. After this button has been bolted to the bell a piece of paper is rolled into a tube as shown at *f* and slipped over the button *b*. A binding post is fastened to the bell as shown at *h*. The diaphragm *d* is cut out of thin tin and the carbon button *c* fastened to it. The carbon grains indicated by the dots in the drawing can be made by pounding a piece of carbon into small bits. The granulated carbon should be sifted through a sieve and only the pieces about the size of a pin head should be used.

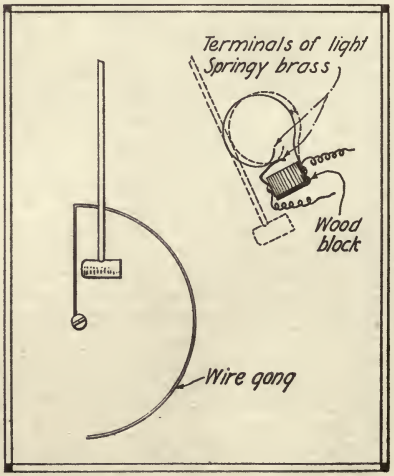
To assemble the transmitter, place a small quantity of the carbon grains in the paper tube *f* and then put on the diaphragm, making sure that the button *c* slips into the tube. The diaphragm is then held in place by soldering three or four small pieces of tin to the edge of the bell and then bending them over the diaphragm. The transmitter may be used without a mouth piece if desired or this finishing touch may be added through the exercise of a little ingenuity.

Contributed by

E. R. Thomas.

Wiring a Clock

The contributor had occasion to wire up a clock in the house so that the hours would be struck in his room. This had to be done without damaging the clock in any way and without interfering with the striking mechanism. It was observed that every time the clock struck, the clapper would recede just before striking the gong. This action was employed to connect the circuit in the manner shown by the appended diagram. Two pieces of very light, springy copper were attached to a small piece of wood and a drop of glue fixed the whole affair to the back of the clock. A glance at the drawing will show that when the hammer is raised before striking the gong it touches the terminal of springy brass, causing



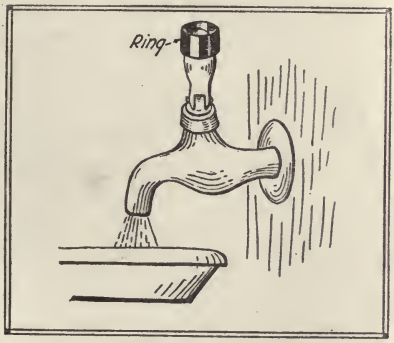
the latter to make contact with the second terminal secured to the wooden block.

Contributed by

E. C. SWETMAN.

Handy Faucet Attachment

Many tubs and basins are equipped with self-closing faucets and if a person desires to let a quantity of water flow, it is necessary to stand and press the thumb springs. The little attachment illustrated makes it possible to grip the thumb pieces of a faucet in such a manner that the water will flow until the device is removed. It is made from a short piece of pipe slightly flattened so



that it will slip over the thumb pieces as they are pressed together.

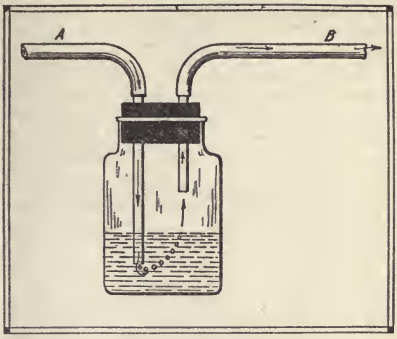
Contributed by

B. W. VERNE.

Preventing Gas Explosions

Acetylene and other gas explosions are sometimes caused by the flame following the gas in the tubing back to the generator or tank. In order to prevent this, a device known as a wash bottle is sometimes used between the source of gas supply and the burner. Referring to the illustration, the tubing *A* is connected to the generator or tank, while *B* leads to the burner.

The wash bottle itself is merely a wide mouthed glass bottle having a perfectly air and gas tight stopper, preferably of rubber, through which are passed two pieces of glass tubing, one reaching nearly to the bottom of the bottle, while the other extends but a short distance below the neck. To prepare the bottle for use it is half filled with water. It is obvious that the gas in flowing down the tube *A* will have to pass up through the water in a series of bubbles before it can escape through the tube *B*. The water thus acts as a check valve, preventing fire from getting back into the main tube leading from the source of gas supply.

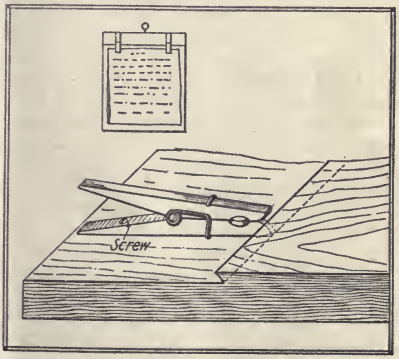


Contributed by

CHAS. I. REID.

Improvised Letter File

Given a pair of spring clothes pins, two small wood screws, a piece of light wood the size of a sheet of stationery,



and a small screweye, the amateur workman can assemble a letter file or clip that will give highly satisfactory service for a long continued period of time. The scheme is outlined in the drawing and the reader will note that the clothes pins are set into a recess. This, however, is not at all essential and to save time the builder may merely fasten the clips to the surface of the board.

Contributed by

B. W. VERNE.

A Handy Clamp

A clamp that may be used to hold work in any desired position is shown in the illustration. The part *D* is to be

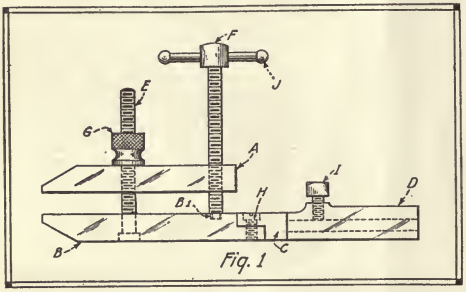


Fig. 1

gripped in the jaws of a vise, and, by loosening the set screw *I*, the clamp may be tilted to any desired angle, while an adjustment laterally may be effected by turning the clamp on the pivot at *H*. The clamp proper is in reality a parallel jaw vise and the merits of this tool are too well known to require further comment. The entire tool is built up from bar steel and the dimensions of the various parts are optional with the builder.

In the clamp made by the contributor the jaws *A* and *B* are ⅝ inch square tool steel, hardened and drawn. The jaw *A* is 4½ inches long and it contains two holes 5/16 inch in diameter, one of which is tapped for the screw *F* to work in. The other hole is a clearance fit for the screw *E*. The jaw *B* is 5⅛ inches long and is counterbored at one end for half its thickness to engage with the counterbored part *C* held by the fillister head screw *H*. *C* in turn is turned down to 5/16 inch to fit in the hole in *D*. The screw *E* is made a driving fit in the jaw *D* and is 3½ inches long. It is threaded for a distance of 2½ inches. The knurled nut *G* is ¾ inch in diameter and hardened. The screw *F* is 3½ inches long under the shoulder, while the latter is ½ inch thick and ⅝ inch in diameter. Through the center of the shoulder is passed a piece of 3/16 inch rod 2 inches long and fitted with ball ends. The end of the screw is turned to 3/16 inch in diameter to work in a hole at B^1.

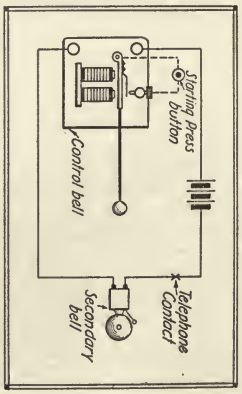
Contributed by

JAMES MCINTYRE.

Automatic Call Bell

Having to call a neighbor to the telephone, the difficulty arose in that the contributor sometimes neglected to attend to the call, resulting in complaints. The call bell was therefore arranged in such a manner that once started ringing it continued until the act of answering the telephone disconnected the bell.

The diagram shows how this was accomplished. The control bell is of the ordinary vibrating type with a long pendulum the contact terminals of which are arranged to be out of contact until the pendulum is put in motion by pressing the starting button. The secondary bell, in the neighbor's house, is connected as a single stroke gong so that it merely repeats each slow stroke of the control bell, this characteristic action distinguishing a telephone call from other uses to which the neighbor puts



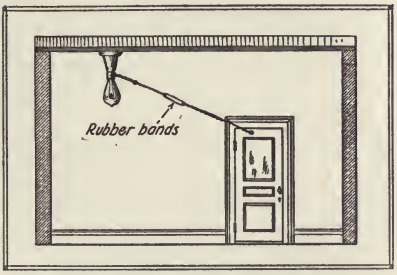
his bell. On starting the bell by pressing the button in the contributor's house, the bell continues to ring until the neighbor by answering the telephone breaks the bell circuit.

Contributed by

EDWIN O. CATFORD.

Opening Door Turns on Light

An arrangement by means of which a light is turned on when a person opens the door to a room and turned off when the door opens and closes on the departure of the person, is suggested in the accompanying sketch. From the pull chain of a socket within the room to a screw-eye fastened on the top part of the door is connected a cord with a number



of small rubber bands attached. The proper location of the screw-eye can readily be determined by experiments and this point will be found near the hinged edge of the door as the required length of movement is quite short. If a hook is placed on the end of the cord where it is attached to the pull chain, the device can be disconnected during the day.

Contributed by

ELBERT N. TODD.

Metal Moulding Knockouts

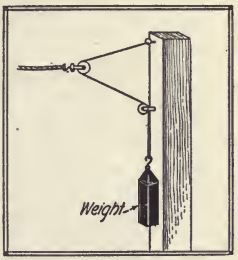
The round knockouts in the bases of metal moulding boxes are sometimes very hard to remove. A simple and easy way to do this is to place the knockout directly over the hole in a roll of tape and strike a sharp blow with a ball peen hammer or a hammer and screw driver.

Contributed by

B. OLSEN.

To Take Up Slack in Clothes Line

The employment of the device shown in the sketch will result in a clothes line that is always neat and taut and one under which clothes props are unnecessary. As the drawing clearly shows, the device consists of a weight attached to the ends of a line which forms a continuous



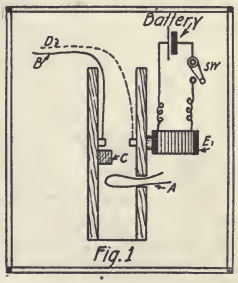
loop through a pulley attached to the clothes pole, on up through a screw eye attached to the upper part of the pole, through a pulley fastened to the end of the clothes line, and thence back to the original pulley on the pole and down to the weight. A glance at the drawing will show that the device will take up the slack within wide limits.

Contributed by

B. W. VERNE.

A Wiring Hint

The sketch shows how a wiring difficulty was overcome. A switch was required at *A* and the block *C* prevented the wire from going down inside the partition. After repeated trials without success, the idea suggested in the drawing was employed. A small piece of iron was fastened to the end of



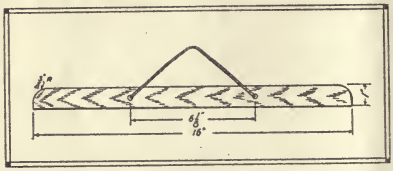
a string *B* and an electromagnet *E* placed against the partition as shown in the drawing. Through the hole, where the switch was to be fastened, a loop of wire was run so that the iron weight held against the wall by the magnet could be guided down through

the loop. This accomplished, it was obviously a simple matter to draw the wire down after it had been attached to the cord.

Contributed by
GEORGE L. MACLEAN.

A Coat Hanger

As shown in the illustration, a serviceable coat hanger can be made by rounding off the ends of a piece of 1 inch

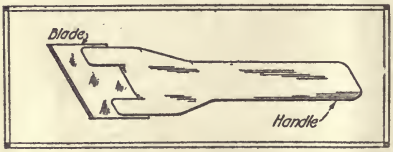


square wood, 16 inches long and securing a short piece of rope or heavy cord at points a few inches on either side of the center. Such a hanger can be made in a few minutes' time out of material to be found in nearly any house and it will prove serviceable and effective notwithstanding its simplicity.

Contributed by
OSCAR WILHELM.

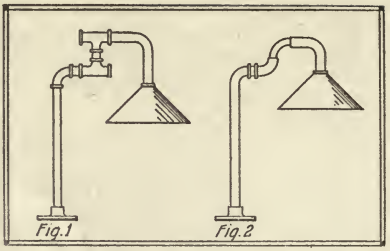
Removing Adhesive Labels from Windows

Papers, placards and labels stuck on windows with glue or paste usually re-



quire considerable scraping with a putty knife for their removal. The little instrument shown in the sketch, however, may be used to accomplish this work very easily and quickly. As the drawing clearly shows, the device is merely a safety razor blade held in a handle of sheet iron.

Contributed by
B. W. VERNE.



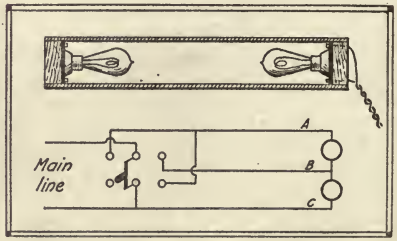
Bench Lamp from Pipe Fittings

The drawings Figs. 1 and 2 show how a handy bench lamp can be made out of a few pipe fittings. The fixture may be adjusted in many directions to meet the requirements of the user. A flange or crowfoot attached to the bottom of the standard will provide a substantial support for the lamp. The construction is so clearly shown in the drawings that further description is quite unnecessary.

Contributed by
GEORGE L. MACLEAN.

Electric Foot Warmer

A simple electric foot warmer offering a superior substitute for a hot water bottle and which takes the place of the more expensive heaters now on the market, is shown in the accompanying sketch. Two 16-candle power incandescent lamps are held in receptacles in the end of a tin tube about 2½ inches in diameter and 15 inches long. A handy diagram of connections is shown in the drawing. By wiring the lamps up according to this diagram it is possible to join them either in series or in multiple by simple movement of the switch, thus affording a ready



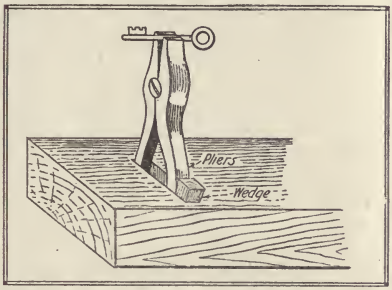
means of regulating the amount of heat liberated within the tube. The complete heater should be covered with a woolen jacket.

Contributed by

MAXWELL SNAVELY.

Pliers as Bench Vise

In the illustration is shown how a pair of pliers may be utilized as a substitute for a bench vise by cutting a slot through



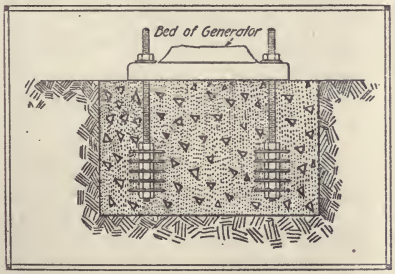
the bench, inserting the handles of the pliers and drawing up with a small wedge of wood. This improvised vise will hold articles to be repaired or filed with surprising rigidity.

Contributed by

B. W. VERNE.

Substitute for Anchor Bolt

While on a recent contract the contributor was confronted with the problem



of devising a substitute for anchor bolts strong enough to hold the bed of a generator down to a foundation of concrete. The problem was met by threading long bolts to the head and placing on them alternately washers and nuts, as shown in the sketch. This arrangement was found to be altogether satisfactory in use.

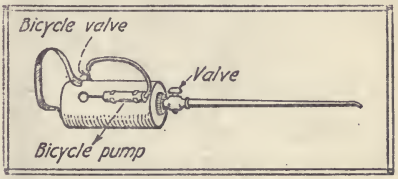
Contributed by

JOHN H. HARDY.

Auto Engine Cleaner

When cleaning the engine of an automobile, the device shown in the illustration will prove to be of material assistance. The materials needed for its construction are: A large oil can with a long spout, a small petcock, a tubular bicycle pump, a tire valve, four pieces of tin and a soldering outfit.

The first step is to remove the handle and spout from the can, cutting the spout into two pieces and soldering the petcock between them, after which the spout is replaced on the can. Four legs are fashioned out of the tin and soldered to the pump, which is then secured with solder to the body of the oil can. The pump should be soldered



well to the front in order that the plunger may be moved back and forth without striking the handle of the can. The reader will note that the handle is affixed to the bottom of the can when it is replaced. A hole is next punched in the rear of the can and the bicycle valve soldered therein. The outlet of the pump is connected with the valve by means of the hose supplied with the pump, after which the cleaner is finished.

To operate the device, fill the can with gasoline and establish an air pressure inside the can by means of the pump. Open the petcock and out comes a spray of gasoline which can be regu-

lated to the desired degree through an adjustment of the petcock.

Contributed by

WILLIAM D. LONG.

To Prevent Skate Strap from Pinching

A shield to prevent the strap of a skate from pinching the foot is shown in the illustration. In addition to this it

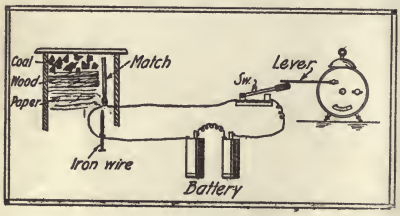
acts as a support for the instep. The device is made in duplicate from a piece of leather and cut to the shape and dimensions shown in the drawing. The reader will note that the buckle of the skate strap comes on the top of the piece of leather which acts as an effective shield.

Contributed by

GLENN G. FOGLESONG.

To Automatically Start a Fire

The contributor suggests a combination of time switch, electric circuit, match and kindling by means of which



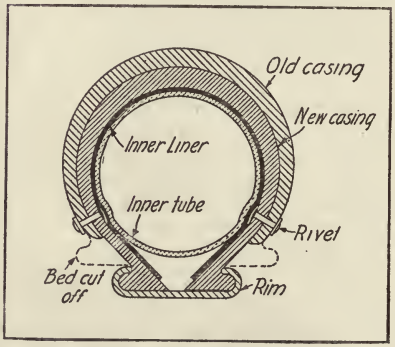
a fire may be started in the kitchen range, for instance, at any desired time during the day or night. It will be noted in the illustration that a piece of fine iron wire is made a part of the circuit through a battery and switch; the latter being closed at a predetermined time by the alarm clock. When the switch is closed the iron wire becomes red hot and lights the match, which in turn sets fire to the kindling in the stove.

Contributed by

JOHN R. WARR.

Reinforcing Auto Tires

Here is a way to make your tires last longer. When a casing gets so old that there is constant danger of a blow out, cut off the beads as indicated by dotted lines, and rivet it onto another casing. To protect the inner tube from chafing against the heads of the rivets a small layer of "tire dough" may be placed over the heads. An inner liner should also be used to further protect the tube. Copper rivets with very flat



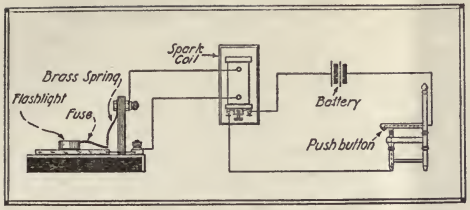
heads are used. A 30 x 3 protector casing may be used on a 30 x 3 or 30 x 3½ casing. A tire protected by this method will give several thousand miles more service.

Contributed by

FRANK G. CAMPBELL.

Device for Flashlight Photography

This device will enable the operator to take his own photograph by flashlight on the mere pressure of a button. The discharging apparatus comprises a battery, push button and spark coil connected in a circuit with a flash pan the construction of which is clearly shown in the drawing. The flash pan

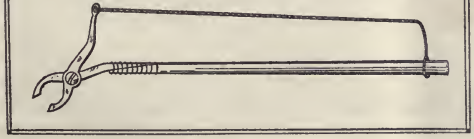


consists of a plate of metal mounted on a base of wood and connected to one terminal of the spark coil, while the other terminal leads to a piece of brass strip fastened to an upright on the base of the flash pan and so adjusted that a short gap is maintained between the metal pan and the brass strip. The flashlight cartridge is laid upon the pan with its fuse inserted in the gap at which a spark takes place when the push button is pressed. The push button is conveniently placed under the arm of the chair in which the operator seats himself when the photograph is to be taken. The camera is set up and focused on the chair. The shutter is opened, the fuse of the flashlight cartridge is dipped in alcohol and the cartridge placed on the flashpan, and when all is in readiness for the exposure to be made the photographer presses the button.

Contributed by CHAS. FICK.

To Remove Articles from a Shop Window

Shopkeepers having a large display of mixed articles in the store window frequently have occasion to remove some article that may be quite beyond reach from the rear of the window. The old method was to use a hook attached to a pole, but this method is not altogether satisfactory. The device illustrated in the accompanying sketch



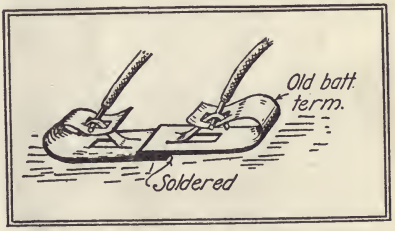
was made from a cheap pair of pliers, a pole of suitable length and light metal rod. The pliers are to be bent as shown, one of the handles wired to the end of the pole, while the other is pivoted to the end of the metal rod as shown in the drawing. By means of this device, any article may be removed from the front part of the window without the slightest difficulty.

Contributed by

B. W. VERNE.

Wire Connector

A handy connector can be made in a few minutes by soldering two of the spring binding posts used on dry cells together as shown in the illustration. Such a connector will enable the experimenter to quickly make and break a temporary connection without the unsat-



isfactory method of twisting wires together.

Contributed by

JACOB LIEBMAN.

Reel for Clothes Line

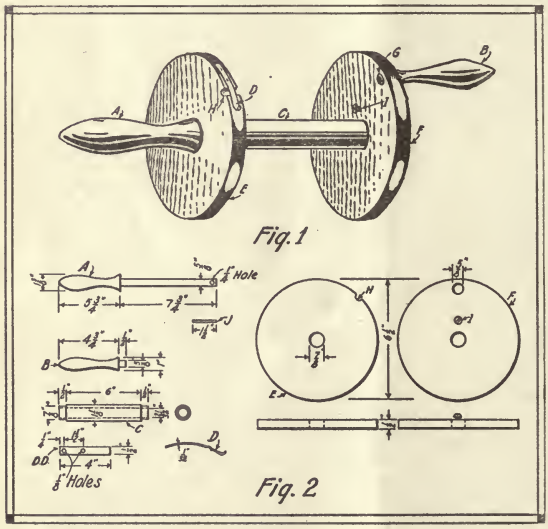
With this device one can wind up the clothes line quickly and neatly on a reel instead of winding in a ball or around the arm, thus keeping it from getting tangled and dirty. The device consists of a reel proper that revolves on a spindle forming a continuation of the handle *A* in Fig. 1. The latter is gripped in the left hand, the clothes line looped over the screw *I*, in the end of the reel and the spool revolved by turning the handle *B* with the right hand.

In Fig. 2 the reader will note the details and dimensions of the component parts of the device. The ends of the reel, *E* and *F*, are discs of ½ inch wood turned to a diameter of 6½ inches and drilled through the center with a ⅞ inch bit. The slot *H* is cut in one disc while the hole near the edge of the other disc is bored with a ⅝ inch bit. In the same disc the screw *I* is placed in position near the center hole.

The spindle with its handle *A* is turned from a piece of 1⅜ inch dowel rod to the dimensions given in the drawing. The washer *J* is to slip over the end of the spindle after the reel has been placed in position. A cotter pin is then inserted through the hole in the end of the spindle to retain the washer. The handle *B* is self-explanatory in the drawing, as is also the core of the reel *C*. *D* is a piece of spring brass placed over the slot *H* in the end of the reel to retain the end of the clothes line after the latter has been wound on the reel. The reel may be painted any color desired, or simply varnished.

Contributed by

PHILIP G. CARLSTEDT.



A Duplicator for the Camera

The simple addition to the camera shown in the drawing will afford endless pleasure and amusement to the photographic enthusiast. By means of this device, one may take two poses of the same person on one plate. For instance, a man may be shown shaking hands with himself.

The device is simplicity itself. It is necessary only to have a piece of cardboard or tin, a thumbtack and a cheap box camera. The first operation is to cut the cardboard or tin into the shape of a triangle, the width of which near the base is just sufficient to cover the lens opening. A clearly defined line is to be drawn down the front of the camera case, crossing the lens at its opening center. The triangle is then to be pivoted with the thumbtack at the top of the camera case as shown in Fig. 1 and tested to see that the lens is completely covered when the triangular piece is perpendicular.

If this is found to be the case, the piece *A* may be pushed to one side until its edge is perfectly perpendicular, as in Fig. 2, and a mark placed on the camera case at this point. The piece *A* is then to be pushed to the opposite side until its other edge is perpendicular and a mark placed as before. These marks are indicated by *C* and *D* in Fig. 3.

To take the picture, the camera is placed upon a tripod or other firm support and an imaginary line drawn as shown in one side of the center line and the shutter *A* on the camera moved to uncover the lens on the same side. The exposure is then made in the usual way. The subject is next moved to the opposite side of the imaginary line and the piece *A* on the camera reversed to cor-

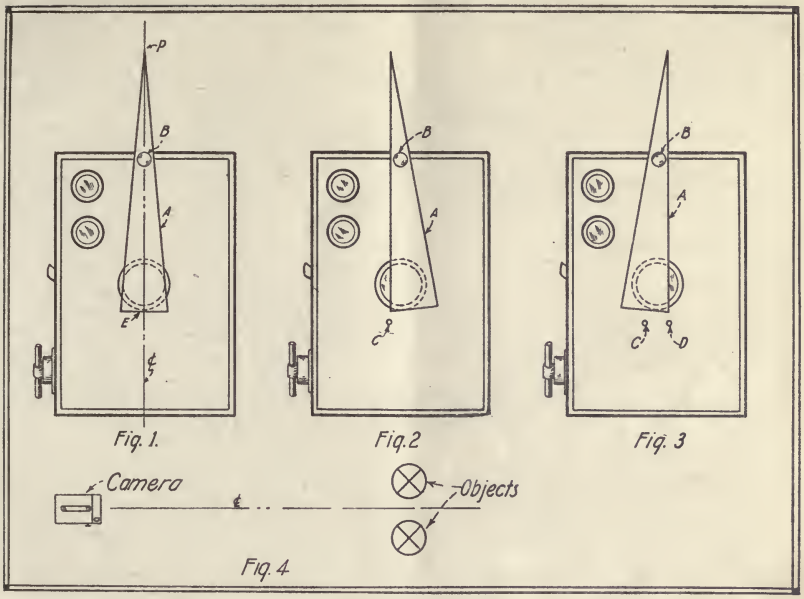


Fig. 1. Fig. 2 Fig. 3

Fig. 4

respond. The second exposure is made and the plate or film developed. In the event that the picture shows an overlap or an unexposed portion between the two halves, it indicates that the length of the triangular piece *A* is not just right. If the defect is an overlap, the piece should be lengthened to broaden the angle of the sides; if the pictures do not meet, the piece should be shortened.

Contributed by

ARTHUR A. BELIVEAU.

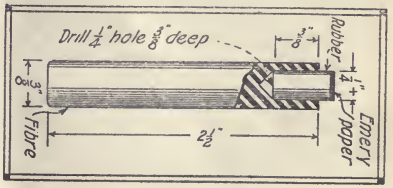
Novel Curling Tool

The tool shown in the drawing will be welcomed by many amateur mechanics who work with brass. The tool will enable one to produce the curling or mottling so often seen as a finish on the brass parts of high-grade instruments.

The tool is made by drilling a hole in the end of a piece of fibre rod, inserting and cementing a short cylinder of gum or springy rubber in the hole and finally cementing a piece of No. 1 G emery paper to the end of the rubber. This latter operation may be performed with the aid of a little sealing wax, but it is preferable to use a cement adapted to rubber and paper. The emery paper is to be trimmed accurately to the edge of the rubber when the cement is hard.

The tool is to be inserted in the chuck of a high speed drill press, speed lathe, or polishing head and the work brought against the rapidly revolving tip of emery paper, shifting the metal until its surface is quite covered with the mottling.

The advantage of the rubber cushion is found in the fact that even though the work is not held perfectly flat against the abrasive, the springiness of the rubber will compensate the difference. Another point in favor of the cushion is the



fact that, owing to the smaller amount of friction between tool and work, the emery paper will last longer than if a solid backing were used.

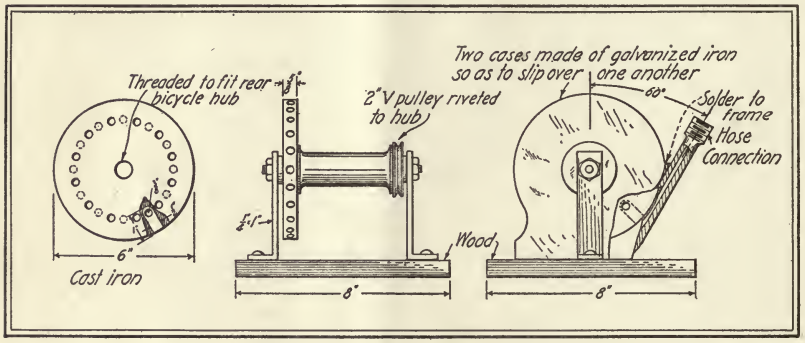
Contributed by

P. J. HOFFMAN.

Water Motor

The details of a water motor, capable of developing about ¼ H. P. on a water pressure of 60 pounds, are given in the accompanying drawings. The rotor is made up of an iron casting in the form of a disc having holes drilled radially in its periphery and secured to an old bicycle hub. The rotating member is mounted between bearings and covered with a jacket of galvanized iron which carries the nozzle. The exhaust water escapes through a hole in the base which may be of wood.

The construction is so clearly shown in the drawings that no further description is necessary, particularly as the design is offered mainly as a suggestion, in the working out of which the builder is expected to use his ingenuity.



Contributed by

FRANKLIN E. TAYLOR.

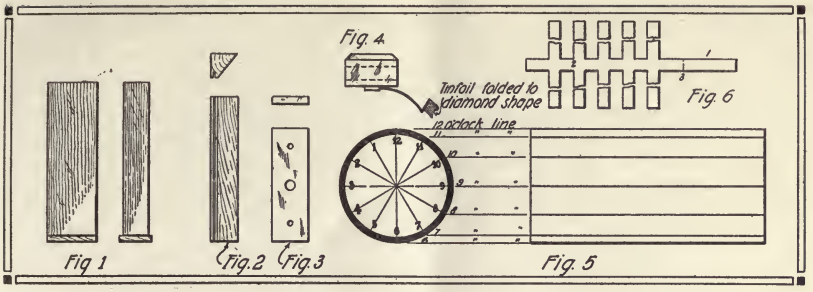
AN ELECTRIC TIME SWITCH

By Harry Brock

The electric time switch described in this article can be used in connection with a burglar or fire alarm or for automatic time signalling. In fact, the limitation of its many uses is due to the fact that nothing heavier than a comparatively small battery current can be handled by the light contacts of the device, although this objection might be overcome through the employment of an auxiliary relay to take care of the main current. The time switch consists of a cylinder revolved by clockwork and so arranged that it may be adjusted to switch the circuit in and out at a predetermined time.

For the revolving mechanism, the works of a discarded clock may well be used. The movement should be removed from the clock case and fitted into two grooved pieces of wood *A A* in the drawing of the completed device. The reason for the V-shaped cut is to make room for any wheels which protrude beyond the framework. The pieces *A A* are nailed to a baseboard about 11 x 7 x ½ inches.

For the revolving cylinder, a piece of fibre tube 5 or 6 inches long and from 2½ to 3 inches in diameter will be required. A cylindrical phonograph record will answer the purpose. Two pieces of



wood should be cut or turned to fit the ends of the cylinder nicely and these heads, G^1 G^2, should have a thickness of at least ½ inch.

To the little tube that originally held the hour hand of the clock is soldered a piece of brass cut 2 by ½ inches, 3/16 inch thick and drilled as shown in Fig. 3. The face and the minute hand of the clock should be removed, the latter being retained for future use.

After marking, drilling and cutting the slot or recess in G^1 where F fits into it, the piece G should be glued into the end of the cylinder.

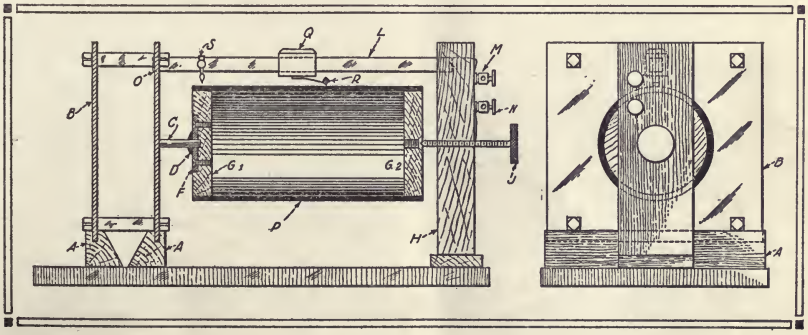
The support H is cut from some hard wood. Place this near the mounted works B and measure up the exact distance that the hour tube C is from the top of the baseboard and drill a hole accurately to fit screw J. This step is to get the dead centre for the revolving cylinder.

The screw forming the bearing which turns on J is made by drilling a small hole about 3/16 inch deep in the head of an ordinary iron wood screw. Drill a hole in G^2 to admit screw, then glue this head into the remaining open end of the cylinder.

Procure a tuning coil slider rod and slider; the former being long enough to reach from point O to support H. The contact portion of the slider should be in the form of a brush as shown in Fig. 4.

Drill a hole at point O on the frame of the clockwork, a little smaller than the diagonal dimension of the slider rod. File the hole square with a triangular file. Bore and chisel a similar hole ¼ inch deep in the support H.

This much accomplished, the more delicate portion of the work is arrived at. Draw the dial of a clock on the end of the cylinder G^2. This should be done with a 30 degree triangle and the utmost accuracy is essential to good results later. Scratch fine lines with a knife point



throughout the entire length of the cylinder. These lines should be at perfect right angles to the end of the cylinder; a try-square being an efficient aid in securing this result.

Get a piece of medium weight tinfoil about 2½ inches wider than the cylinder and cut it so that it comes together neatly when wrapped about the cylinder. Proceed to cut it as in Fig. 6, making as many sectors as there are combinations desired. The ends of the sectors must meet when they come around the cylinder. Glue this piece of tinfoil on the cylinder so that the rib 2, Fig. 6, travels along the 3 o'clock line. While the glue is still damp, secure a razor blade and treat each sector as follows:

Let us assume that one combination is to be 9 P. M. to 7 A. M., *i. e.*, we wish to make the circuit at 9 P. M., and break it at 7 A. M. The sector is cut off at the seven o'clock line, and at the nine o'clock line, in order that a break may occur in the continuity of the ring of tinfoil. Care should be taken to make the sector cuts accurately.

The numbers on the end piece must run in the opposite direction to those on a clock dial for the reason that it is the cylinder, and therefore the numbers, that revolves.

The slider rod is next to be placed in position and secured with a bit of solder applied at point *O*. Take the minute hand of the original clock and solder it to the slider rod at the point *S*. Cut off the projecting portion and bend the pointer so that if a line were drawn from the contact point on the brush (Fig. 4) to the pointer *S*, it would be perfectly parallel to the time lines scratched on the cylinder. This pointer is used to set the apparatus to standard time.

The completion of the assembly is now in sight. Screw the plate *F* to the cylinder end G^1. Bend over the projecting lug of tinfoil *I*, Fig. 6, and make a hole large enough to let the screw in end G^2 of cylinder pass through it. Drive the screw home and adjust the pivot screw *J* upon which the cylinder turns. Test by turning the setting screw at the back of the works to determine whether the cylinder revolves accurately on its bearings.

Connect the screw *J* to the binding post *N* with a wire and likewise connect slider rod with binding post *M*.

To set the clock, let us assume that it is 8 P. M. and that we wish to use the 9 P. M.—7 A. M. combination, for example. The cylinder is revolved until the little pointer *S* points directly down to the 8 o'clock line. The clock switch should be set that way in the beginning to get it accurately adjusted and regularly wound to keep it going. If it is necessary to set the clock at a point between the even hours, say at half past six, the pointer should be placed at a point half way between the six and seven lines. If the quarter hour is essential, the pointer should be adjusted in proportion, just as it is on a regular clock.

The apparatus is, of course, connected in series with the circuit it is intended to control.

ELECTRICITY AND FIRES

Contrary to the prevailing opinion among persons with a slight knowledge of electricity, recent figures indicate that there are less conflagrations due to electric current than many other causes.

There were nearly 5,000 fires reported in Chicago during 1913. The records show that less than one per cent. could be laid to electricity. Only one fire was caused by lightning. Careless use of matches caused 164 fires in 135 days; stoves, chimneys and flues caused over 300; 52 fires were incendiary; spontaneous combustion caused 51; 46 were due to carelessness in handling gasoline; thawing water pipes caused 43; explosions of gas, 38; and oil lamps, 35.

Thus it would seem that those who are prone to say the fire was caused by "crossed wires" when they can think of no other reason, are striking wide of the truth. It is but another piece of evidence in favor of man's most faithful servant.

A CRAFTSMAN CEDAR CHEST

Describing the Construction of a Paneled Cedar Chest With Suggestions for the Design of Others

By Ralph F. Windoes

Instructor in Manual Training, Davenport High School, Davenport, Iowa.

Illustrations from drawings made by the author.

RED cedar—the peer among chest woods—can be found growing all over our entire country. From the Atlantic to the Pacific—from Florida to Minnesota—this beautiful and fragrant wood grows. In most places it sparsely covers extensive areas (cedar brakes), and does not attain any great size, but in the southern states, especially on the west coast of Florida, it is highly prized as a commercial product since there it grows to a suitable size for lumber. One of its most important uses has been in the making of lead pencils, as it whittles easily and is very light. Its consumption in the pencil industry alone is several million feet a year—hence the rapid depletion of the supply.

Although these cedar facts are interesting, we are more concerned just at present in its use as a cabinet wood, and especially in chest construction. An ideal chest wood must be light, as chests are handled a great deal, it must be firm and strong for the same reason, and it must present an attractive appearance. The cedar fills this list completely and has the added attraction that no other wood possesses—its aroma, combined with its moth-repelling qualities. Moths shun the red cedar wood as other insects shun the pennyroyal herb, and costly furs or woolen goods placed in a cedar chest are moth-proof for ages. Its aroma is so fragrant that the articles may be taken out of the chest, worn at once, and not have a repulsive smell such as that left by the ordinary moth ball. Altogether, then, the red cedar wood made into a chest produces a very pleasing article of furniture, and one that should be in every home.

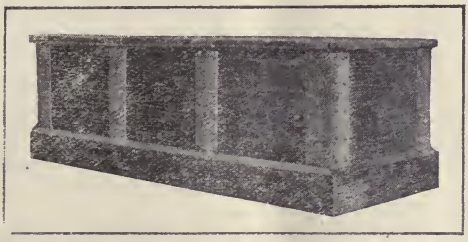


Fig. 1.—An Attractive Cedar Chest made by High School Boy under the Direction of the Author.

In this article the author offers complete working drawings for a paneled chest, as well as suggestions for the design of several others. The description will apply to the one detailed, but any one of the others can be worked up acceptably without difficulty.

In the first place, it is not always necessary to decorate a cedar chest with copper embellishments. Some styles demand it while others abhor it, and the craftsman must be guided by his own sense of the ugly and beautiful when planning his own. The photographic illustration accompanying the working drawing shows a chest that would have been much more pleasing if the copper strips had been omitted altogether, since they tend to efface the stiles of the panels and give them an "all rail" appearance. If the craftsman who intends to follow this design will bear this in mind and produce corners that do not show a bad crack where joined, he will find that he has a much better looking chest if he leaves the copper off. With this particular chest, the box was fastened with flat head screws and the corners were added to cover these heads.

A study of the working drawing will reveal the following pieces in the list of stock:

2 pcs.	⅜″	x 13 ″	x 36 ″	, side panels.
2 pcs.	⅜″	x 13 ″	x 13 ″	, end panels.
4 pcs.	¾″	x 2½″	x 38 ″	, side rails.
4 pcs.	¾″	x 2½″	x 15 ″	, end rails.
4 pcs.	¾″	x 2½″	x 18 ″	, side stiles.
4 pcs.	¾″	x 1¾″	x 18 ″	, end stiles.
1 pc.	¾″	x 20 ″	x 42 ″	, top cover.
1 pc.	¾″	x 16½″	x 38½″	, bottom.
1 pc.	¾″	x 2 ″	x 38 ″	, feet.
2 pcs.	1½″	x 1½″	x 17¾″	, corner blocks.

This stock should be *sand papered* at the mill to exact dimension, thereby saving the craftsman additional hours of labor which would of necessity be spent in "cleaning up" the wood by hand.

Let us begin the construction by making the panels. A study of the detail will show that the rails are tenoned into the stiles. Cut the mortises in the latter first, laying them out very carefully and comparing them side by side before doing any cutting. They will be made ⅜″ wide, 1½″ long, and 1¾″ deep, as the detail shows.* As they open on the top it will be a little easier to clean them out than they would be if entirely blind. Next, lay out the tenons that fit into them, and cut them carefully with perfectly square, sharp shoulders. The drawing shows that the panels are let into the rails and stiles to a depth of ½″, and at their exact centers. These panel grooves can be cut out with a router plane or a combination plane, while if a power saw is handy they may be cleaned out with the dado head.

When these parts have been carefully fitted, glue and clamp them together. It is not wise to put any glue along the edges of the panels, as they shrink and swell with variations in the weather and if held by glue at these points they might force out the rails or crack them open.

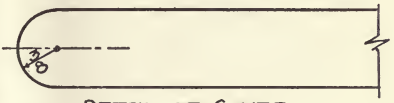
When the glue has dried and all that is on the outside has been carefully cleaned off and sand papered, these pieces will be ready to assemble. Decide upon the method of fastening you intend to use. If you insist upon using the copper corners, the best method is by means of countersunk flat head screws, 1¾″ No. 9. If you do not care for the metal corners, glue and nail with finishing nails, the heads of which may be set and filled with a mahogany paste filler which will show but little after the finish has been applied. The bottom is also fastened with nails in the same manner. The top cover has a rounded edge and is hinged with two brass hinges on its under-side. It is checked from falling back when opened by means of a desk support or a piece of brass chain. In each corner glue a triangular corner block, made by ripping the two square pieces on a diagonal of each. (Notice the detail.)

The feet are mitered for each corner and are nailed into place, as the detail plainly shows. The addition of casters or polished steel slides completes the construction.

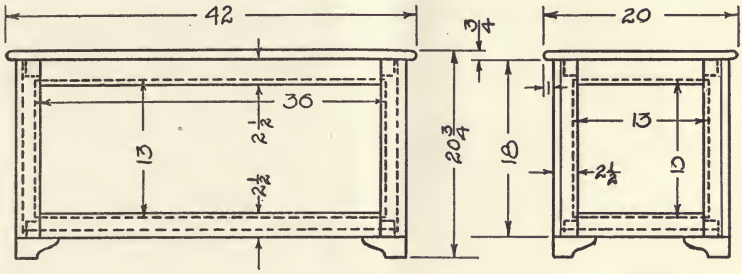
As the description seems a trifle condensed, a few words of caution may

* If the craftsman does not know the correct method of laying out and cutting mortise and tenon joints, he should refer to an article of this series that appeared in the January number of MODERN MECHANICS.

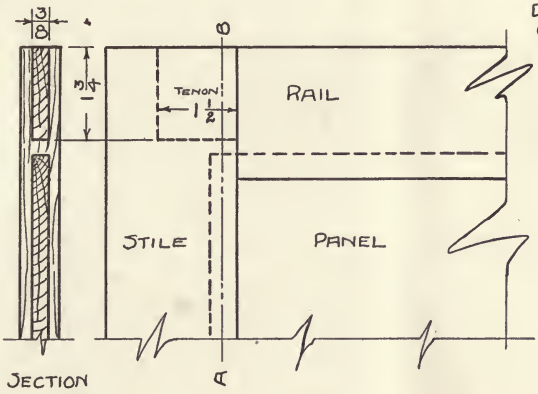
CEDAR CHEST



DETAIL OF COVER

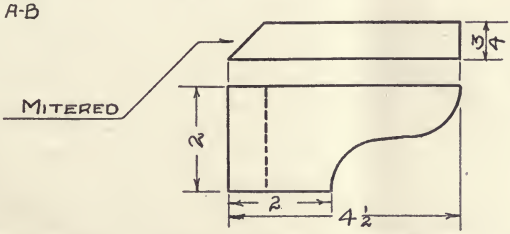


DETAIL OF CORNER BLOCK



JECTION ON A-B

DETAIL OF PANEL CONSTRUCTION



DETAIL OF FEET

W.

serve the amateur well. In the first place, strive to obtain good corner joints so that the copper strips will not be necessary. Good joints cannot be obtained unless the edges of the ends are perfectly straight and square, so try your utmost to accomplish this. Be very sure, also, that when the box is nailed together, the corners form right angles. If they have a tendency to spring after the clamps have been removed, the square cornered bottom will probably straighten them out if it fits snug. The feet should be carefully mitered and the end grain of the miter should be given a glue size before the final gluing and nailing. By "glue size" we mean the placing of a thin coat of glue on the end grain and allowing it to harden before giving it the final coat. If casters are used, glue and nail a block about 1½" square and 2" long on the inside of each corner into which fasten the caster.

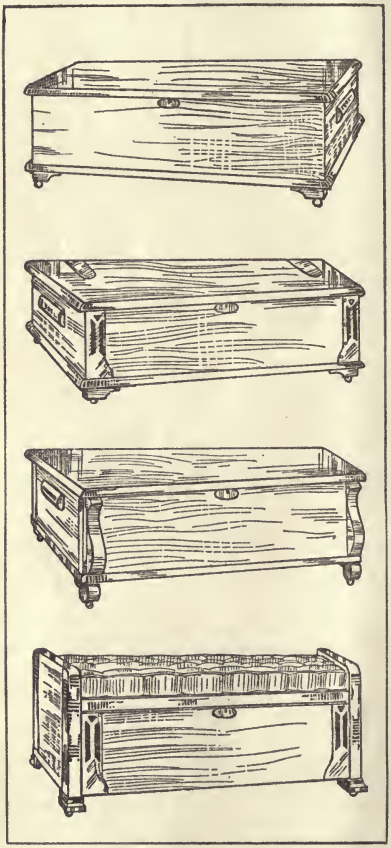


Fig. 2.—Four Suggestions for a Cedar Chest.

To bend the metal corners to right angles, place them between two pieces of hardwood held in the vise so that one-half of each strip is even with the top of the pieces of wood. This half may then be driven over flat with a mallet.

Some craftsmen may prefer the chest with the straight sides to the paneled chest that we have described, hence we have illustrated a few designs that may assist him in his planning. In Fig. 1 we have a photograph of a chest made complete, including the gluing up of all stock from narrow boards, by an eighth grade boy in the Davenport, Iowa, schools. It has copper corners and bands, and a mitered base—a good design, yet massive.

In Fig. 2 will be found four suggestions. At the top is a simple design very similar to the chest described but with straight sides instead of panels. The bottom is the same size as the top and is screwed up into the box. Below is illustrated the same chest with the addition of copper corners and hinge plates. The designs are sawed from the metal with a small jeweler's saw frame. The next shows an elaborate chest with scrolled pieces nailed at the corners, giving it a heavy effect, otherwise the box has the same construction as the other designs. Lastly is a good design for the experienced craftsman to undertake. The heavy square corner posts are tenoned onto the end pieces and the sides. The top is set down from the ends and a tufted cushion is made for the cover.

Regarding the finish: Apply nothing to the inside of the box as you will want the cedar smell to remain unrestrained, but the outside should be given a rubbed varnish finish. First, apply a coat of white shellac. After twenty-four hours, rub it down smooth with No. 00 sand paper or steel wool, and give it another

coat of the same. After waiting another twenty-four hours rub it down again, and apply a coat of some *high grade* rubbing varnish, carefully following the directions on the can regarding the temperature, etc. When this coat has thoroughly dried—it may take two or three days—rub it down smooth with pumice stone and water, and wipe off clean. Give it another coat of the varnish—a flowing coat—and when this has hardened perfectly rub it down with pumice stone and oil. If carefully done, this should give a good finish. Of course, the copper embellishments are not placed until the piece has been finished in this manner. The copper may be polished with pumice and water, and given two coats of banana oil to effectively prevent it from tarnishing.

THE FLEXIBILITY OF THE INDUCTION MOTOR

By E. E. George

FEW of the users of induction motors are aware of some of the interesting characteristics of this type of apparatus.

It is not generally known by the experimenter that the induction motor, whether of the slip-ring or cage-wound type, may be used as a generator under certain conditions, chief of which is that it must be loaded onto a live circuit, as the motor will have no field or magnetism unless the line onto which it is loaded has another source of power sufficient to excite the motor field at all times. As a rule, any line that will run an induction motor at no load, will, with proper adjustment of generator voltage if necessary, permit an induction motor to be loaded onto it. The motor must be run slightly overspeed. For instance, an induction motor running idle at 1,800 R. P. M. which might give 5 horsepower at 1,760 and 10 horsepower at 1,720, would give back 5 horsepower to the line if run by some external source of power at 1,840 and 10 horsepower at 1,880 R. P. M. This relation does not hold true exactly, due to motor losses.

In case of a central station breakdown, where part of the synchronous generating equipment is disabled, induction generators could be used temporarily to carry most of the load.

The slip-ring induction motor is often used as a frequency converter, although it may also be used for transforming voltage and phases. The frequency of the current in the rotor of an induction motor equals the stator frequency multiplied by a fraction whose numerator is the synchronous speed of the motor minus the actual speed, and whose denominator is the synchronous speed. Speed in the direction the motor tends to run is considered positive, and speed backward is considered negative. Thus it is readily seen that any desired frequency of alternating current may be produced by driving the motor at the proper speed. The ratio of rotor voltage to stator voltage depends upon the speed, frequency and winding, but the rotor voltage is usually 110 at zero speed. Practically all polyphase motors have three-phase rotors. Thus, a two-phase slip-ring motor makes a good device for obtaining three-phase current from two-phase lines, or *vice-versa*. The motor may be driven by a direct current motor, by an induction or synchronous motor off the same source of power, by some external source of energy, or by an induction or synchronous motor operating off of the new frequency produced.

This latter device is called the interlocked frequency changer because of

the definite ratio of the two frequencies, depending only on the synchronous speeds and pulley ratio of the two motors. It is used where one has but two motors available for the frequency transformation, one suited to each frequency.

The squirrel-cage type motor can also be used as a phase converter. Single phase current may be drawn off of two lines of a polyphase circuit without unbalancing the circuit greatly. The motion of the rotor tends to divide the single phase load among all the phases. A modification of this device has proved very valuable in single-phase railway work. A three-phase motor, after being started in any way, can be connected onto a single-phase line and three-phase current can be taken off of its terminals. The experimenter will find this a very valuable device for obtaining polyphase current from a single-phase supply.

Anyone who is thinking of installing a large number of single-phase motors with their costly and complicated starting devices, will find it far cheaper and very convenient to use one large three-phase motor, keeping it running idle on the line at all times, and loading the small three-phase motors onto three lines from its terminals. The large motor will need to be started but seldom, and never under load, so it may be started by hand or with a split-phase device.

ELECTRICAL RESISTANCES AT VERY LOW TEMPERATURES

It may be remembered that some time ago Professor H. Kammerlingh Onnes, of the University of Leyden, made some very interesting discoveries regarding the decrease of electrical resistance in a conductor at very low temperatures. In a note recently presented to the French Academy of Sciences he relates his further experiences in following the same line of experiments. In studying the resistances of metals at the very low temperatures which can be obtained with liquid helium, Prof. Onnes calculated that the resistance of mercury would still be easy to measure at 4.25 degrees above the absolute zero (—268.75° C.), but that it would continue to diminish with lower temperatures in such a way as to become negligible at —271°. Recent experiments have verified these calculations as to the diminution of resistance with decreasing temperatures, and at the same time they have brought to light the unexpected fact that the electrical resistance disappears very suddenly. Mercury at 4.19° Kelvin (which is the name given to these temperatures above the absolute zero) passes without any warning into a new condition, which is characterized by an extreme mobility of the electricity. This state, in which currents can be maintained in a conductor without appreciable electromotive force, has been called the "superconductor condition."

The time of persistance of a current once established in a circuit and abandoned to itself without electromotive force is extremely short in ordinary cases; for superconductor circuits, however, it may become so great that the currents are practically permanent.

In his communication to the Academy the Professor gives an account of the various experiments which have led to these additions to our electrical knowledge.—J. H. BLAKEY.

The buildings of the Panama-Pacific International Exposition are being painted by means of improved air brushes. Electric current is employed to heat the varnish applied over the paint, so that it may flow more freely through the orifices of the air brush.

In operation, the airbrush utilizes the principle of an atomizer, the paint or varnish being drawn up through a tube, at the end of which is a nozzle.

How to Make and Sail an Ice Boat.

By Chas. A. Meyer.

OF all winter sports ice boating is the most exciting. The sensation of flying over the ice with the speed of the wind and the sting of the frosty air and bits of ice in one's face, accompanied by the cracking of the sails, is perhaps more exhilarating than that offered by any other form of sport.

On some rivers and lakes where the surrounding country is too level for coasting or skiing, ice yachting is the chief winter sport. Such is the case on the North Shrewsbury River in New Jersey. Sometimes, when the ice is good, the entire river about the towns of Red Bank and Fair Haven is dotted with these craft which appear like so many large white gulls with wings outstretched.

The yachts vary greatly in size, ranging from the small one-passenger affairs to the great boats which carry a dozen or more people at the same time. The boat described below is capable of accommodating two or three persons when there is a good breeze.

Fig. 1 is a side view of the craft complete. In Fig. 2, which is a detailed plan of the body, the backbone, marked *A*, is a 3 x 4 inch piece of timber tapered slightly at one end. The runner-plank, *B*, is a 2 x 8 inch plank. The side rails, *C*, *C*, are 1½ x 4 inch strips set edgewise. Almost any kind of boards may serve as the flooring, *D*. The runners, *E*, *E*, are loosely bolted between the runner blocks, *F*, *F*, *F*, *F*. *P* is a hole, one inch square and one inch deep, cut into the backbone to hold the mast. Another hole, *G*, ⅞ inch in diameter, is bored through the backbone to hold the tiller post.

RUNNERS

The two front runners are cut from hard wood two inches thick. The size and shape can be found in Figs. 1 and 3. Through each runner, equidistant from the ends and one inch down from the top, there is a hole one-half inch in diameter. Along the bottom of the runners make a V-shaped groove one-quarter inch deep. The third runner, which acts as a rudder, is cut from hard wood 1½ inches thick and is 14 inches long. The shape and width are the same as those of the other two runners.

Three runner irons must be made as follows: Procure some square iron rod ¼ or 5/16 inch on a side. Select a piece

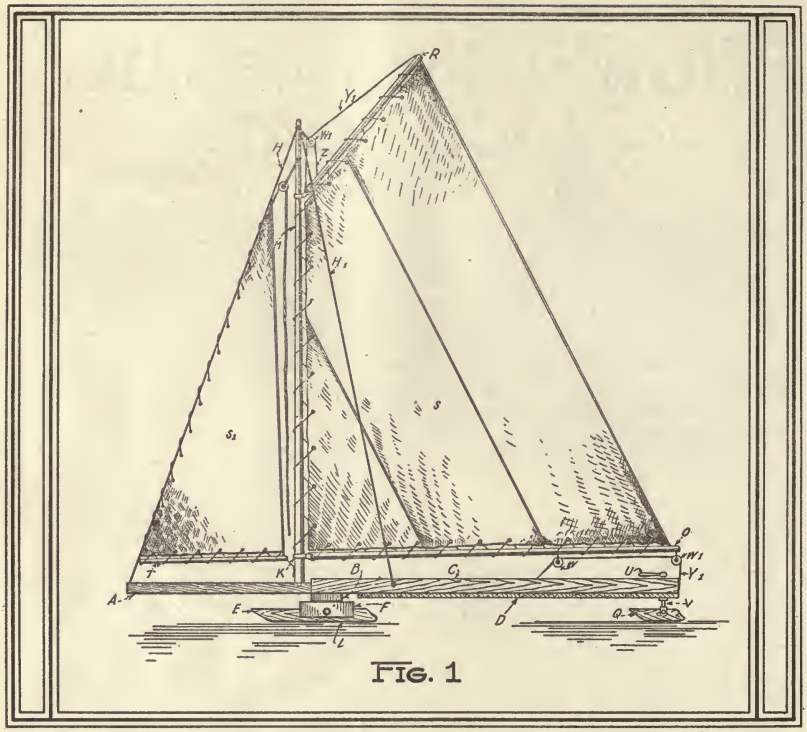


FIG. 1

just as long as the runner to which the iron is to be fitted. Bend it edgewise so that it will run along the bottom of the runner and up the curved part at front and rear for a space of two inches. Then flatten each end of the rod a little and drill holes through the flattened part to take wood screws.

When all three irons have been made fit them into the grooves in the runners and screw them firmly in place with long, stout screws. Sharpen with a file the edge which will bear upon the ice.

RUNNER BLOCKS

Four runner blocks, *F*, Fig. 3, will be needed. These parts are cut from hard wood and are 14 x 4 x 2 inches. Three-quarters of an inch below the center of each block there is a hole, *N*, ½ inch in diameter.

TILLER POST AND HANDLE

These parts must be made by a blacksmith. The shape and size may be seen from Fig. 4. The tiller consists of a round iron rod ¾ inch in diameter, split at one end and drilled so that the rudder may be bolted between the prongs. Just above the split part there is a flange which prevents the tiller post from slipping up through the hole in the backbone. The top of the rod is made square for a space of one inch. Two small holes, ⅛ inch in diameter, are drilled through the square part, the first one ¼ inch from the top, and the other a trifle below the point where the rod changes from round to square.

The tiller handle is a round iron rod the same thickness as the post. It is flattened at one end and has a square

hole made through it which is just large enough to fit snugly over the tiller post.

MAST AND SPARS

The mast is a round stick of spruce or pine 2½ inches thick at the bottom and gradually tapered to 1¾ inches at the top. It must be cut down square at the bottom to fit into the hole in the backbone. The boom, *O*, Figs. 1 and 5, made of the same material as the mast, is 2 inches in diameter throughout the whole length. The jib-boom, *T*, and the gaff, *R*, are round sticks 1½ inches thick.

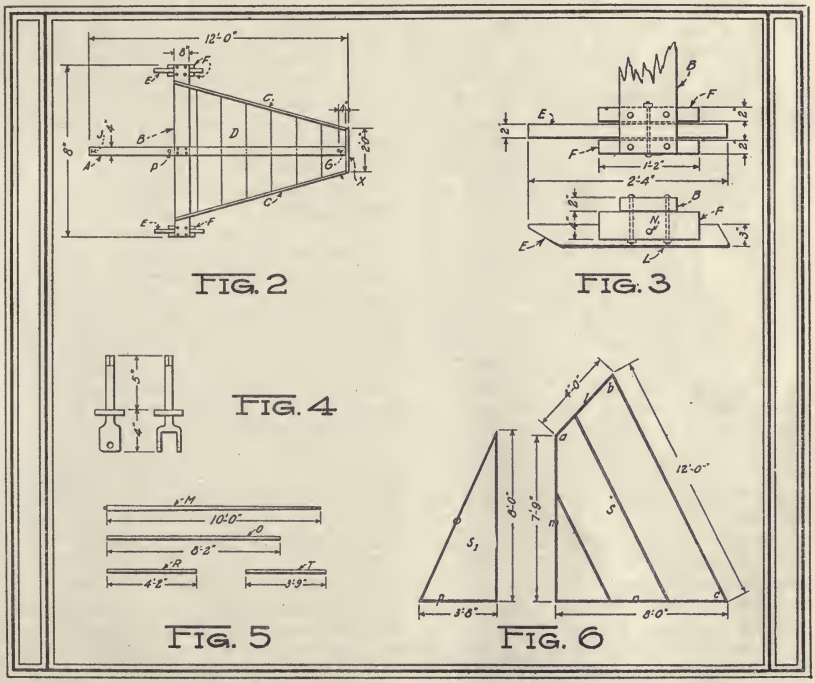
ASSEMBLING THE PARTS

Place the backbone over the runner-plank and at right angles to it in the position shown in Fig. 2 and bolt the two firmly together. Fasten the cross-piece, *X*, to the rear end of the backbone with screws. Secure the side rails to the runner-plank with bolts and to the cross-piece with nails or screws. Screw the flooring to the under side of the side rails and backbone, and drill a hole directly under the hole, *G*.

Bolt the rudder between the prongs of the tiller post and push the latter up through the hole, *G*. Then fit the tiller handle over the tiller post and secure it in place with two pins thrust through the two holes in the top of the post.

Bolt two runner blocks to each end of the runner-plank as in Figs. 2 and 3, with just enough space between them to allow the runners to fit in loosely. Be sure that the two pairs of blocks are exactly parallel or the boat will not run well. Now place the runners between the blocks so that the holes in each come opposite, and run a 7-inch bolt through both. This arrangement allows the runners to move up and down when any roughness in the ice is encountered.

Place the mast in the hole, *P*, and secure it in place with three heavy wire stays, *H* and *H'*, Fig. 1. (Only two are



shown in the sketch.) One of these stays is brought down to an eyebolt in the tip of the backbone and the other two to eyebolts in the side rails. The boom and gaff are fastened to the mast with rings of copper or brass wire, made large enough to slide freely up and down. Two ropes, *Y'* and *Z*, tied to the gaff, are brought through the pulley *W'*, and wound around a cleat on the backbone. These ropes make it possible to hoist the mainsail up or down at will.

SAILS

The mainsail *S*, and the jib, *S'*, are made from yard-wide stripe of canvas or sail cloth of any kind. In looking at the plans, Fig. 6, it might at first seem a simple matter to map out the sails. But such is not the case. The simplest way to accomplish the task is as follows: Select a large room with a bare floor on which to work. Draw on the floor a straight chalk line 8 feet long. At one end of this line and perpendicular to it draw another line 7 feet 9 inches long. The lines may be made perpendicular by using a large steel square or by drawing the plan in the corner of a square room. Now fasten a few feet of twine to a piece of chalk. Make a loop in the twine at a distance of four feet from the chalk. Drive a nail at point *a*, Fig. 6, and loop the string over it. Then, handling the chalk like a pair of compasses, draw an arc through point *b*. Change the position of the nail to point *c*, and, using twelve feet of twine, make another arc cutting the first at point *b*. Join points *a*, *b* and *c* with two straight lines and the plan of the mainsail is complete. For the jib, start by drawing a straight line 3 feet, 8 inches long. At one end of this line and perpendicular to it draw a line 8 feet long. Connect the extremities of these lines with a third line, thus forming a right angle triangle, and the plan of the jib is finished. Now it will be found a simple matter to cut the sails to the proper shape by laying the strips of cloth down over the chalk plans. Be sure to have the strips run as in the illustration or the sails will not hang well. All seams must be double stitched with strong thread. A hem one inch wide should be made along all edges of both sails and eyelets worked in, about one every foot, on the sides *l*, *m*, and *n* of the mainsail, and on the sides *o* and *p* of the jib.

PUTTING ON THE SAILS.

When the sails have been completed hoist the gaff to within about two feet of the top of the mast and fasten it there. Then lace the mainsail to the mast, boom and gaff with quarter inch rope of a good quality. Lace jib to the front wire stay and to the jib-boom as shown in Fig. 1. A length of rope tied to the end of the jib-boom and wound on a cleat will allow more or less sail to be "let out." Another rope, *K*, fastened to the top of the jib and run over a pulley, *W*, allows this sail to be hoisted up and lowered. The rope controlling the swing of the mainsail is rigged as follows: Fasten it to an eyebolt in the rear cross-piece, *X*, Fig. 2. From there bring it over two pulleys, *W*, *W*, on the boom, and finally tie it to a cleat on the backbone.

The appearance of the boat will be greatly improved if the body, runner blocks and runners are painted some attractive color which will show up well against the ice. The mast and spars would look well if shellaced or varnished with some waterproof preparation.

HOW TO SAIL THE YACHT.

When the craft is on the ice always turn it toward the direction from which the wind is blowing and turn the tiller crosswise before hoisting sail. For ordinary sailing both sails should be regulated by the ropes controlling them so that they can swing about a foot to either side. When the sails have been hoisted take the tiller in one hand and push the boat around sideways to the wind. Then straighten out the tiller and run along a few steps till the craft is fully under way. An ice boat should be handled about the same as an ordinary sail boat. To stop, "throw the boat up into the wind"; that is, point it in the direction from which the breeze is blowing.

The cost of electrical cooking has been reduced more than 40 per cent. by the introduction of the so-called "fireless electric cooker."

DESIGN FOR A SMALL DYNAMO

Description of the Construction of a 30-Watt Generator of Simple Yet Efficient Design

By Chas. F. Fraasa, Jr.

Illustrations from drawings made by the author.

THE following design is for a small direct current dynamo following the best practice in small dynamo construction, embodying as it does, a laminated slotted drum armature; built up, mica-insulated commutator; cast steel field magnet, giving increased efficiency; and a reasonable speed. The capacity of the machine operating at a normal speed of 2,500 r.p.m. is 30 watts. The design gives winding data for 15 volts 2 amperes as a dynamo. The machine will operate equally well as a motor, but at a lower speed. Fig. 1 shows the completed machine.

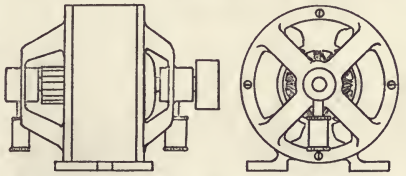


Fig. 1.—Side and End Views of 30-Watt Generator as it Appears when Completed.

The dynamo is easily constructed. All the machine work may be done on a lathe of 7-inch swing. Directions are given for making the patterns so that the builder may make them himself, and cut down the cost of the castings.

The patterns are built up to the proper thickness from a number of thicknesses of white pine, and secured together by pattern maker's glue. Patterns to be turned are glued to a disc of one inch pine fastened to the lathe face plate with screws. A piece of heavy paper should be glued between the pattern and the disc to facilitate the removal of the pattern. The patterns should be given a slight draft from the parting line, that is, the parts of the pattern should be thicker at the parting line, so that the pattern may be removed from the mould without tearing the sand. Holes of large diameter in proportion to their length will form their own cores. Holes of small diameter in proportion to their length, such as the holes in the bearing hubs, will have to be cored out. When the pattern has been turned to shape it is finished by sand papering it with No. 0 sand paper and given a coat of shellac. This will raise the grain of the wood. Sand paper again, and apply another coat of shellac. The patterns are almost too small to make any practical allowance for shrinkage, but 1/8 inch must be allowed all dimensions for machining.

The yoke and the magnet cores of the field magnet are cast separate so that the field coils may be wound on a form, and then placed on the poles, when they are secured to the yoke by means of machine screws. Fig. 2 dimensions the finished yoke casting. The pattern divides along the line *A*—*B*. The two parts of the pattern are secured together while turning by means of four 3/16 inch dowel pins. These dowel pins are glued in one of the parts of the pattern, and fit snugly in holes in the other part. These pins should remain in the patterns, as they are used by the moulder to locate the two parts of the pattern in the mould. Remember that the dimensions given in the illustrations are finished dimensions, and to add 1/8 inch to each dimension where it is to be machined. The recess *C* is not turned in the pattern, but in the finished casting.

The two pole pieces and magnet cores are cast together as in Fig. 3, and machined to fit the yoke ring, when the you attempt to machine them. With a piece of emery cloth, clean all the sand and scales off of the castings and grind off any rough, irregular spots.

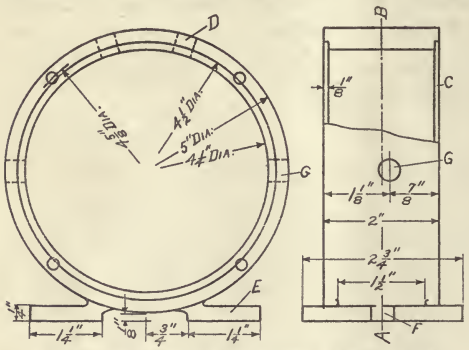


Fig. 2.—Dimensions of the Finished Yoke Casting.

Mount the yoke ring, Fig. 2, in the lathe, and bore it out to 4¼ inches in diameter. Face the end and turn a recess *C*, 4½ inches in diameter, and 1/16 inch deep. Then clamp a block of iron to the face plate and turn up a supplementary face plate to snugly fit the recess in the yoke ring, and clamp the yoke ring to it. The other end may now be faced and the recess turned. Drill two 5/16 inch holes *D* in the top of the yoke ring casting for the terminal binding posts. The base lugs *E* should be finished by grinding to shape. The bottom surfaces should be in line, so that the machine will stand level. A ⅜ inch hole *F* is drilled in each lug and then cut open with a hack saw to form a slot ⅜ inches wide and ¾ inches long. This slot is for the bolts which hold the machine down. The holes *G* for the cap screws

material *B* between the pole tips is cut away. Fig. 3 gives the finished dimensions. In the pattern, make the cores ⅞ inch long, and the armature 2⅛ inches in diameter.

The housings are illustrated in Figs. 4 and 5. A pattern will be required for each. The pattern is built up to the required thickness and turned inside and outside. Drill a hole in each of the windows, and cut along the lines of the arms with a coping saw. The windows are then trimmed to shape with a sharp knife. The flange *A* is not turned in the pattern but in the finished casting. It will therefore be necessary to make the ring *B* ⅜ inch thick. Turn the core prints *A*, Fig. 5, from some pine, and mount one in each end of the housing hub, gluing it in a ¼ inch hole drilled in the centre of the hub. The parting line of the mould is the inside of the housing, so draft will accordingly be made on the arms and the hub.

The brush holder pattern, Fig. 7, is so simple as to require no explanation. The hole *A* cores itself, and should be given a slight draft to the surface *B*.

The yoke and the pole pieces are to be cast from a good quality of steel. The housings and the brush holder may be made of cast iron.

When you get your castings from the foundry, they should be cleaned before

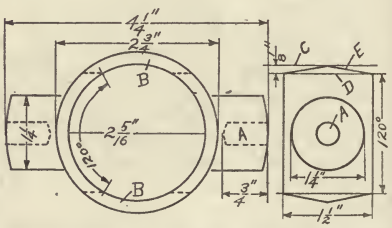


Fig. 3.—Casting for Two Pole Pieces and Magnet Cores.

which hold the magnet cores in place are drilled ⅜ inch in diameter. Be careful to locate these exactly as indicated in the illustration, as upon this depends the uniformity of the air gap, and the centering of the armature between the bearings. If the holes are too far to one end, the armature will pull to that end and rub against the bearing.

The casting of the pole cores is chucked in the lathe and the core ends

are turned down to a diameter of 4¼ inches. The armature tunnel is bored out to 2 5/16 inches in diameter, and the

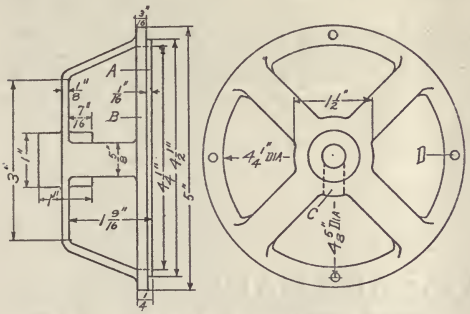


Fig. 4.—A Housing as it Appears When Finished.

ends faced off so that the poles will be 1½ inches wide. The hole *A* in each of the pole cores is drilled with a 9/32 inch drill in the center of the pole, and tapped ⅜ inch, 18 threads per inch. In the armature tunnel, locate the center of each pole. With the dividers set at 1 5/32 inches between points, scratch a mark on each side of the center. Then set the divider for 1 9/32 inches, and scratch another mark. Through these marks on each pole face, scratch parallel lines *C* and *D*, Fig 3, and from the center of the line *C* draw the lines *E* to the ends of the lines *D*. This will give the pole face the shape, Fig. 3. For mounting the pole pieces in the yoke ring, procure two ⅜ inch cap screws one inch long.

Chuck the housing and bore the bearing hub out to 9/16 inch in diameter. Mount the housing on a mandrel, bracing it well, and face off the hubs. The flange *A*, Fig. 4, is then turned 4½ inches in diameter and faced off so that it will be 1/16 inch thick. This flange should make a snug fit in the recess turned in the yoke ring. The hole *C* is drilled ¼ inch, and tapped 5/16 inch, 18 threads per inch for the grease cup which lubricates the bearing. To drill the holes *D*, fit the housings to the yoke ring, and drill a 3/16 inch hole through the housing at the points located. Then continue with a No. 29 drill into the yoke ring and tap for a 3/16 inch 24-thread per inch screw. Drilling in this way will insure the alignment of the holes in the housing and the yoke ring. The bearing is a piece of brass or phosphor bronze one inch long, 5/16 inch internal, and 9/16 inch external diameter. This is bored out and mounted on a mandrel and turned down to a snug fit in the housing. The bushing is driven in place, and a ⅛ inch hole is drilled through it from the center of the hole *C*, Fig. 4. The bearing is then reamed out with a 5/16 inch reamer. The commutator end housing should have the inside hub turned down to ⅞ inch in diameter for the brush holder.

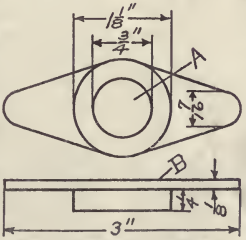


Fig. 7.—Pattern for Brush Holder.

A grease cup dimensioned in Fig. 6 consists of a tube *A* one inch long, having its ends threaded internally to receive the two caps *B* and *C*. The caps *B* and *C* are turned from brass rod, and threaded to fit the tube *A*. The *C* cap has a ⅛ inch hole drilled through it for the wick *D*, which lubricates the bearing. A coil of brass wire *E* is bound to the wick

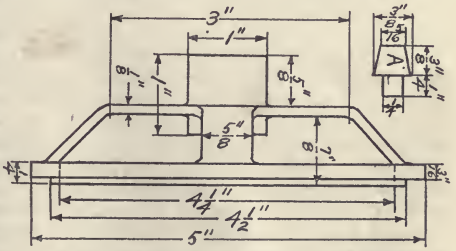


Fig. 5.—Construction of Pattern for Housings.

D to force it against the shaft, thus providing a constant supply of oil to the shaft.

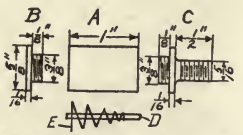


Fig. 6.—Parts of a Grease Cup.

This concludes the description of the machine work on the generator.

In the March issue of MODERN MECHANICS, the author will cover in detail the winding of the field magnet and armature of the 30-watt generator, together with a description of the assembly of the machine and suggestions for an appropriate and attractive method of finishing it.

HOW PINS ARE MADE

The making of such a common and everyday commodity as a pin involves quite a number of steps from the raw material to the finished product. But every operation is performed by machinery so that the cost of pins is remarkably low.

The first step in the manufacturing of pins is when a pair of jaws seizes the end of a brass wire which is wound on a spool and draws out a length corresponding to the size of the pin. The wire runs on steel posts, which serve to straighten it. The wire is then caught by two clamps and a cutter clips off enough wire to make one pin. A small length of wire is left projecting to make the head. The latter is formed by three rapid blows from a hammer which moves forward one-twentieth of an inch after each blow.

The pins then drop from the clamp and run down an incline beneath, in which are grooves large enough to admit a shank, but which will not permit the head to pass through. As the pins move down the inclined plane, the points come in contact with a revolving cylinder beneath. This cylinder, the surface of which is like a file, comes in contact with the pins on only one side as they move down the grooves. This causes them to turn around so that the revolving file sharpens them eventually on all sides. The pins next drop from the grooves into receptacles and are cleaned from grease by being dipped into an alkaline solution.

The process that follows is the tinning of the pins. This is accomplished by placing in a pan a layer of finely ground tin, then a layer of pins, another layer of tin, and so on until the pan is filled. A solution of bitartrate of potash is then poured in. The application of heat makes the solution of tin with which the pins are coated.

The pins are then polished by placing them in barrels and revolving them rapidly. The friction thus produced highly polishes the pins in a short time.

Pins are papered by an ingenious little machine which saves a great deal of labor. It is nothing more than a steel box under which is a sliding frame that seizes the paper and crimps it into divisions as wide as the length of the pins. The bottom of the box is made of little square steel bars spaced at such a distance apart as to allow the shanks but not the heads of the pins to pass through. The bars are kept in motion, thus shaking down the pins until a row is formed, when they are clamped in place by the bars. A fold of paper is pushed up against them until they are pressed into place. This process is repeated until the paper is filled, when a new one takes its place.

THE MYSTERIOUS CAGE

By G. C. HINES

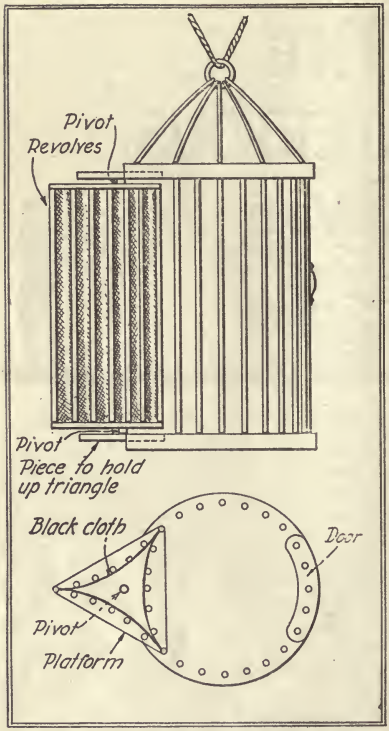
THE illusion about to be described is in all probability a familiar one to a great many readers. In offering this experiment the performer first calls attention to a large iron cage suspended in mid air. The cage is about 4 feet in diameter and 8 feet high. The performer's assistant, a young girl of about 10 years of age, enters the cage by means of a stepladder and two wing-shaped curtains are then let down until they just cover the front of the cage. Within two or three seconds the curtains are raised and the girl is seen to have grown into a young lady. The curtains are again let down and when raised for the second time the young lady is seen to have changed into an old lady. To prove that the effect is not accomplished by means of a change of make-up and costume, the curtains are lowered and when raised again, all three of the assistants are seen standing inside of the cage. A ladder is placed in position and the assistants descend.

In view of the fact that the cage is off the floor and at least 10 feet away from the back curtain, and also that the audience can see through the cage, thus proving that the other two assistants are not concealed therein, this illusion is a most effective one. The secret of its production is a simple one and it is through the time-worn method of using a special back drop that the illusion is performed.

The cage is made as shown in the illustration and is about 8 feet in height to the top of the dome. In the back of the cage the bars are removed for a space of about 3 feet and in the middle of this space in both top and bottom of the cage are placed metal brackets in which pivots are secured. Two pieces of wood are then cut into triangles each side of which is slightly less than 3 feet in length. Bars are then placed in curves on these boards as shown in the drawing. The reader will note that the radius of these curves is the same as that of the cage itself; the bars set into the triangles, therefore serve to complete the cage.

A back drop, preferably of black velvet, is placed across the rear stage and pieces of the same material as this drop are fastened along the inside of the bars of the triangles as shown in the figure. Thus we have a structure with three platforms and this affair is to be located so as to revolve freely on the pivots secured in the top and base of the cage.

Assuming that the cage has been suspended over the stage and that the drop is in position, the performer is ready to attempt his experiment. The young lady assistant is located on one of the platforms in the rear while the old lady occupies the remaining platform. The audience will, of course, be unable to distinguish between the black material backing up the bars on the triangular platform and the material forming the back drop. Thus it will appear as though a clear view through the bars of the cage were to be had. The child is



Details of Apparatus for Producing the Mysterious Cage Illusion.

permitted to enter the cage and the curtain let down. The child then steps upon the platform which is revolved, thus bringing the young lady into the cage. The curtain is raised to show the young lady and then lowered to effect the change into the old lady. When it is desired to bring all three assistants into the cage for the finale, the platform is revolved until the three assistants have taken their places.

USE OF GOLD IN CERAMICS

Gold is used on pottery either for gilding or as a coloring agent in glazes. Its value for gilding lies in its resistance to oxidation and the fineness of the layer which can be produced, for which reason it is not an expensive stain. The aid of a flux is employed in application, and mercurous oxide is found to reduce the amount of gold required. The following mixture is recommended:

Fifteen parts of black mercurous oxide, 2.5 parts of basic bismuth nitrate, and 0.3 parts of melted borax; the addition of three parts of silver carbonate to this composition producing a greenish tint. After firing in the muffler the gold has a matt surface and must be polished with bloodstone or agate. A cheaper process, which does not require polishing after the burn, is the use of "Glanzgold" or "Meissen gold," a preparation of gold solution with an organic medium such as turpentine, lavender oil and a balsam or resin. As a coloring agent in glazes, gold produces shades from violet to purple and red, of which the best known is purple of Cassurs, a lake of precipitated gold with metallic hydroxide, preferably that of tin, which was formerly regarded as a definite compound. The presence of ammonia or alum in the stannous chloride solution produces shades from dark to rose purple, and the tint may be further modified by the substitution of antimony or magnesia for tin. Choice of flux materially influences the color. Various recipes are given which contain lead oxide, borax or felspar, and kaolin may be used as a base for the lake. In lead glazes one part powder will produce a deep red glaze, and in leadless glazes, one in 10,000. An underglaze stain can be produced from 50 parts of pegmatite, 50 of alumina and one of gold chloride. Gold may be applied under a glaze on places previously moistened with gum tragacanth solution.

A Berlin professor estimates the commercial value of electricity represented by a single flash of lightning lasting for one-thousandth of a second, at 29 cents. If this energy could be conserved and rendered commercially available, it would serve to light the average six or seven room cottage for nearly a week.

HOW to MAKE a MICRO-DETECTAPHONE

By Fred H. Fries

DESCRIBING the Construction of a Micro-Detectaphone of Simple Yet Efficient Design that May be Used for the Same Purposes as the Commercial Type Employed by Detectives.

ALMOST all amateur experimenters have around their radio station an old telephone receiver and possibly some of them have an old transmitter, but there are few who have a sensitive microphone. In the following the author has endeavored to describe a microphone that he has used for some time and which is so sensitive that he can hear a train leaving a station seven squares away from his home, as well as hear people talking in the house next door.

To commence with, you first construct the wire frame *B*, which is made by taking a piece of No. 8 B & S gauge wire, 19½ inches long. Measuring 7½ inches from one end, bend the wire at right angles. Then measure 4½ inches from the first bend and again bend at right angles, resulting in the frame *B*. Next construct diaphragm *D*, which is a piece of No. 24 B & S gauge tin, 4⅜ by 4¾ inches. Now cut two pieces of spring copper *C*, either No. 34 or 36 B & S gauge, and have them 2¾ inches long by 3/16 inch wide. Take diaphragm *D* and solder strips *C C* to it, also to frame *B*, (see sketch). Next construct the adjustable contact point *G*, which is another piece of No. 34 spring copper 4 inches long and ½ inch wide, having three holes in it and bent as per enlarged sketch. *I* is a piece of No. 1 lead pencil cut in the manner shown and inserted in the two holes made in the copper strip *G*. Construct the adjusting screw *E*, which is a copper pillar ½ inch in diameter and 2 inches high, with a hole drilled in it and then tapped out to receive a threaded rod. This rod may be any size, but ⅛ inch rod was the size used by the author. The manner in which the copper pillar *E* and the adjustable contact *G* are fastened to the base, *A*, is clearly shown in the sketch. In order to fasten wire frame *B* into place, measure 4½ inches on the base and then make two holes a trifle smaller than the wire and force the wire ends into the holes.

After the parts are assembled and the wire is run on the underside of the base to binding posts *F F* at the edge, as shown in the sketch, take the instrument and set it on a perfectly level place and see where the carbon point *I* touches and mark it on the tin. Now cut a small piece of carbon *H*, a ½ inch square by ⅛ thick and glue it on the diaphragm *D* at the point where carbon point *I* touches.

The micro-detectaphone is then ready for service, and by looking at the hook-

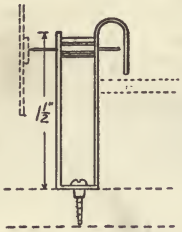


Fig. 4—Detail of Contact Point.

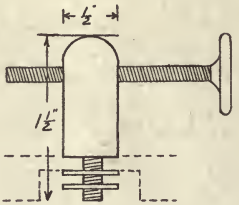


Fig. 5—Detail of Adjusting Screw

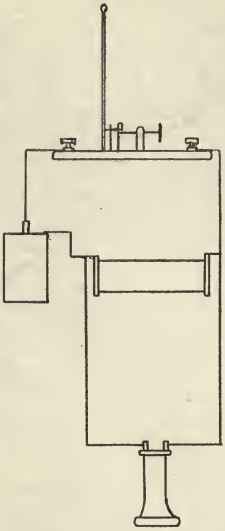


Fig. 3—Hook Up

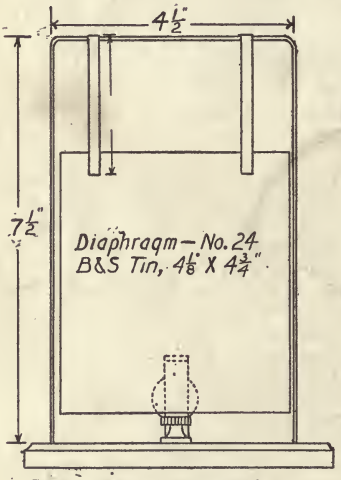


Fig. 1—Front Elevation

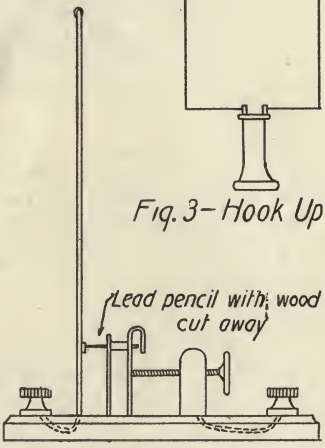


Fig. 2—Side Elevation

up you can see how to run the wiring. *A* is the instrument, *B* is the battery, *C* is an ordinary telephone induction coil, and *D* an ordinary telephone receiver. It will be seen that the receiver is connected to the secondary side of the induction coil. With a little practice it will be possible to adjust the device to render it as sensitive as most dictagraphs on the market at present.

If you enjoy MODERN MECHANICS, tell others; if not, tell us.

ELECTRICAL ILLUMINATING HINTS

Recently, an illuminating engineer of the General Electric Company gave the following helpful rules:

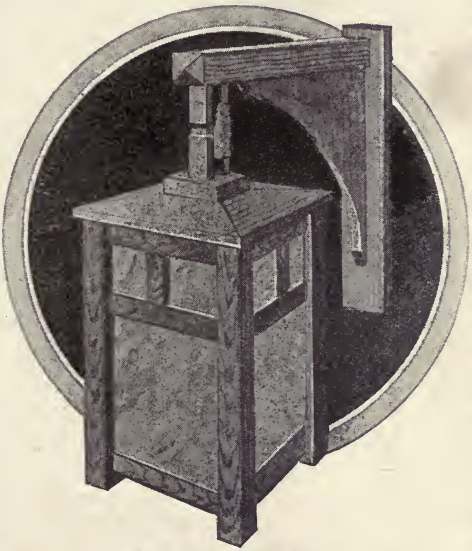
Dust lamp globes and shades as often as furniture, or at least once a week.

Keep a supply of unused lamps of various sizes in the house. Don't wait until the lamps are broken or burned out, to secure new ones.

Always replace a burned out lamp with one of the same wattage.

A Wall Lamp in Wood and Artglass*

OF the many different types of art-craft lamps suitable for amateur construction, probably none is more useful than the wall bracket design providing it be made of moderate size and of simple design. By the latter is meant a design comparatively free from ornamentation. It is believed that the lamp illustrated in the wash drawing on this page combines both of these features in a design that is at once dignified, unobtrusive and artistic. Its appearance in the daytime is quite as pleasing as at night when it is lighted.

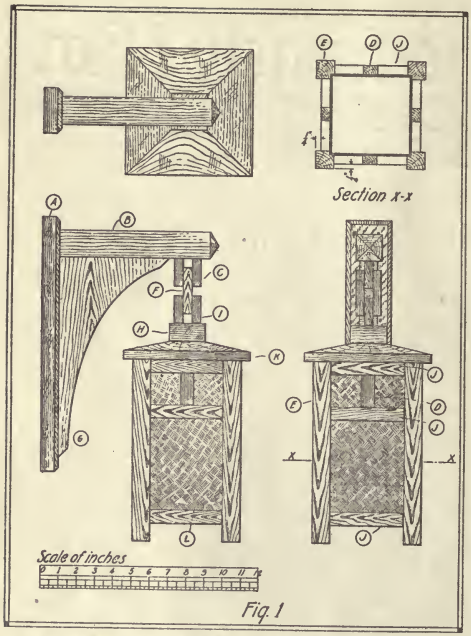


View of Completed Lamp.

In Fig. 1 the reader will see line drawings that show the plan and side and end elevations of the completed lamp, as well as a section through the body of the lamp to show the method of securing the artglass panels in position. The dimensions are not given in these drawings as their presence would serve only to confuse. Instead, the scale of the drawings is to be seen in the lower left hand corner of the plate and by cutting this scale out of the page and pasting it on a piece of thin cardboard, the reader may take at a glance the dimensions of any part in the assembled views by using the scale as a rule and reading the dimensions in inches.

The exact dimensions of the various pieces from which the lamp is made up are given in the detailed drawing, Fig. 2. The number of pieces of each size required is also to be seen under each drawing. The summary of this drawing is given in the bill of materials which follows and it is necessary only to add that the wood referred to is oak unless the individual worker prefers some other stock, to match the finish of a certain room, for instance. Oak is very practical as it can be stained to a variety of shades and it takes a nice finish. The stock should be ordered cut to size unless the builder is well equipped with tools and does not object to the extra

*This article is one of a series dealing with the construction of lamps in many different designs that has appeared in the November, December and January issues of this publication.



Showing Front, Side and Top Views of Completed Lamp.

labor involved. At any rate, the material should be ordered planed to the thickness required in the finished piece.

(*A*) 1 piece wood 1" x 2½" x 14".
(*B*) 1 piece wood 1½" x 1½" x 9¼".
(*C*) 2 pieces wood ½" x ½" x 1½".
(*C*) 1 piece wood ½" x ½" x 1½".
(*D*) 4 pieces wood ½" x ¾" x 1¾".
(*E*) 4 pieces wood 1" x 1" x 10".
(*F*) 2 pieces wood ½" x ½" x 2½".
(*F*) 2 pieces wood ½" x ½" x ½".
(*G*) 1 piece wood 1" x 6" x 11".
(*H*) 1 piece wood 1" x 2" x 2".
(*I*) 2 pieces wood ½" x ½" x 1½".
(*I*) 1 piece wood ½" x ½" x ½".
(*J*) 12 pieces wood ½" x ¾" x 4".
(*K*) 1 piece wood 1" x 7" x 7".
(*L*) 4 pieces artglass 4⅜" x 8⅛."

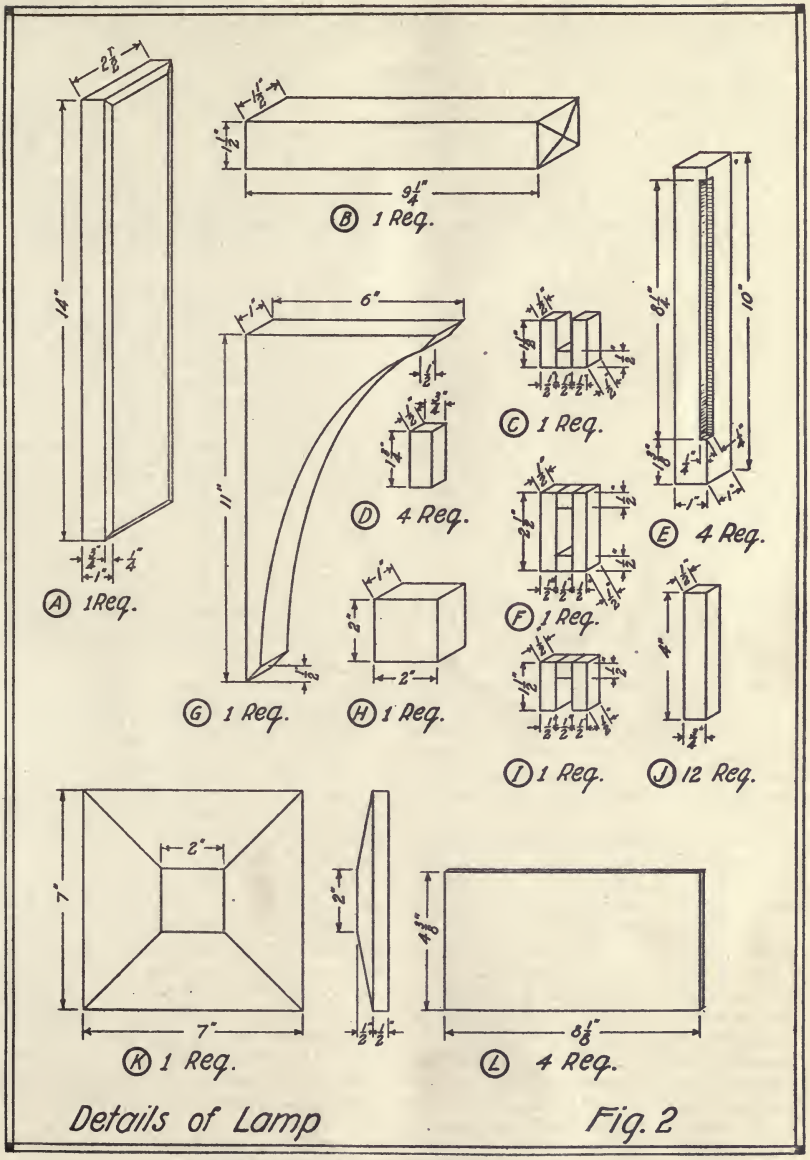
In the above bill of materials the reader will note several repetitions and in preparing the order for the mill, the total number of pieces of each size required should be specified.

It is believed that few words of explanation are necessary in order that the average reader may clearly understand the construction and assembly of the lamp. The first piece to consider is the back board *A* upon which the lamp is supported. This piece should be cut accurately to size, the bevel planed on the edges, and the whole piece sandpapered with a piece of very fine paper. To this piece the arm *B* is attached after it is finished up in like manner. The assembling may be done with flat head wood screws and slender wire finishing nails supplemented with glue carefully applied, but it is preferable to use dowels if the task of placing them is not beyond the ability of the worker. In the case of the back board and arm, *A* and *B*, respectively, the use of screws is quite admissible and in fact advisable as the heads are concealed when the lamp is attached to the wall.

The bracket piece *G* is cut to shape by means of a pattern maker's or compass saw and the surface and edge nicely finished with sandpaper. The bracket is then to be located beneath the arm *B* to which it is secured with dowels. The attachment to the back board may be accomplished with screws from the back.

The construction of the links of the chain is clearly shown in the detailed drawings, Fig. 2, and indicated by *C*, *F* and *I*. The reader will note that the links are built up of separate pieces of ½ inch square stock. The assembly is preferably with dowels and glue, although slender nails may be substituted for the dowels. The small nail holes are easily filled and concealed by means of paste wood filler worked up with stain to the color of the finish that is placed on the wood.

Before fastening the upper link to the arm, the latter should have a ¼ inch hole drilled through its center from the back and extending to a point midway between the pieces of the upper link. A hole to meet the first one is then drilled up from beneath in order that the flex-



Showing Dimensions of the Parts of the Lamp.

ible wire to carry current to the lamp may be passed through the arm, coming out between the pieces of the link through which it passes on its way down through the top of the lamp.

Next in order is the block *H* to which the lower link is attached. This block is secured to the top of the lamp, which is a solid piece of wood, broadly beveled as shown at *K*. To the top the worker will fasten the corner posts *E*, first cutting the section of ¼ inch stock away from each as shown in *E*, to provide a support for the artglass sides of the lamp. The function of the cuts is shown in the sectional view in Fig. 1. The spreaders *J* and the decorative pieces *D* are next prepared and fitted in their respective places preferably with glue and small dowels.

The pieces of artglass *L* should be ordered cut to the exact size as it is difficult for the amateur workman to secure a clean edge on this glass without the skill and tools of the professional. Each sheet of glass is to be placed in the lamp by holding the glass diagonally in the opening through the bottom of the lamp. When the glass is in its place, a few small brads tapped into the corner posts will secure it. The bottom of the lamp may be left quite open or it may be closed with a square piece of artglass.

The incandescent bulb is held in a receptacle secured to the top of the lamp *K* in a manner that is obvious to the worker.

The color of the glass and the finish of the woodwork are, of course, optional with the builder and there is little to be said other than to suggest a color scheme harmonious with the interior decorations of the room in which the lamp is to be used. The woodwork should be stained and preferably waxed or else treated to a rubbed shellac finish to be in keeping with the rugged, simple outlines of the design.

AN ELECTRIC SPY SYSTEM FOR FACTORIES

Electrical engineers have shown much interest in the suggestion of an electric spy system. By this is meant the application of electricity and suitable recorders in order that a record of the work performed by machines and employees would be available at the end of each day.

The scheme has been tried in a cement mill and it is now possible for the management to secure accurate information regarding the operation of every machine. It is impossible to conceal delays from the recording devices.

A suggestion has been made for employing such a system in a factory, so that it will keep a record of the time at which the machinery was started in the morning, the operation or failure to operate of every machine, and even the opening and closing of the various doors, from room to room, up till the blowing of the whistle at night.

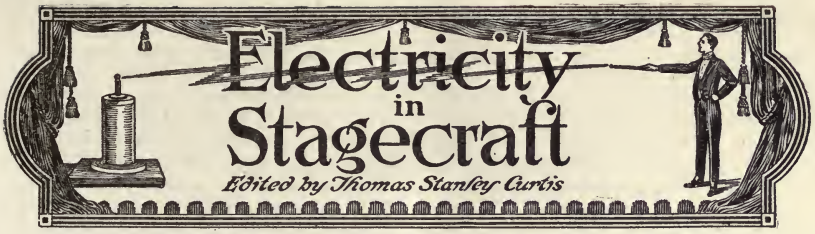
The idea of an electric spy system seems to have originated from the use of recorders in power houses that keep a permanent record of breakdowns, heavy loads and other conditions.

INTERESTING FACTS CONCERNING BIG GERMAN GUNS

Frederick A. Talbot, a well-known writer in many fields, gives many interesting facts regarding the big German guns in a recent article appearing in the English *World's Work*.

According to Mr. Talbot, the German army is equipped with 10.5, 28 and 42 centimetre guns, which in English measurements are regarded as 4¼, 11, and 17 inch weapons. Contrary to the prevailing opinion the fortresses of Liége, Namur and Antwerp were for the most part reduced by the 28-centimetre type of gun. It is stated that the larger siege weapons had been built with the intention of using them against the fortifications of Paris.

The 28-centimetre gun is quite mobile, being mounted on a large gun truck fitted with caterpillar wheels.



Apparatus for a Spectacular Vaudeville Act*

ASSUMING that the apparatus described in the past five numbers of this magazine has been built according to instructions, the builder will be interested to connect up and test his outfit. The connections are simple, as the accompanying drawing indicates, and it is only in some few particulars that the author need supplement with further explanation.

A switchboard is highly desirable but not at all essential to the successful operation of the apparatus. One may be made quite simply and without the expenditure of much time or money. A pilot lamp, to enable the operator to see the control switches in the dark; a 50 ampere double pole, single throw knife switch to control the transformer circuit; and a small snap or knife switch for the spark gap motor circuit, will complete the equipment of such a simple board. This adjunct to the outfit may be made quite elaborate, if desired, just for the theatrical effect it may have if placed upon the stage. In this event, the board, which may be of wood treated with a fireproofing compound, should be finished eventually in a dead black to simulate slate. The switch equipment may be supplemented with fuses, imitation bus bars and additional lights. An ammeter and a voltmeter will not only add to the appearance, but will also be of practical service in the operation of the apparatus.

The transformer requires a current of from 40 to 50 amperes at full load and the leads from the stage pocket must necessarily be of heavy cable. The stage cable used in connection with motion picture arcs is admirably adapted to this purpose and the outfit should include from 50 to 100 feet of this cable.

Connection between the transformer secondary and the rotary spark gap electrodes may be made with the high tension cable used in the ignition circuit of automobiles. This cable is to be fitted with substantial lugs as in use it will have to be connected and disconnected a great many times.

The oscillation circuit comprising spark gap, condenser and primary of oscillation or high frequency transformer should be connected with the special cable described in the October number in which a description of the connecting lugs for the primary of the oscillation transformer also appears.

The ground connection shown in the diagram is of the utmost importance as without it the high voltage surge back through the transformer wires will be almost sure to puncture the insulation of the transformer. To further protect the latter and to safeguard the house wiring, a protective condenser should be connected across the transformer primary at the point where the line wires are connected. This condenser is made by joining two 2-mfd. telephone condensers in series across the line and grounding the neutral point or wire that connects the two.

For the sake of simplicity, the spark gap is shown as a stationary one rather

* This article is one of a series that has appeared in every issue of this publication from September, 1914, to date.

than a rotary. The connections are, of course, the same for the two.

When all has been connected up, the spark gap electrodes may be adjusted to the point where they just miss the rotating member and the gap motor started. For this first test, the primary clip of the oscillation transformer may be placed on the center turn to permit of variation in either direction as required to establish resonance. The main switch may next be closed and the ball discharger at the top of the oscillation transformer should send forth long streamers of fire with a terrific crackling noise. An adjustment of the clip on the primary from one turn to another, and a variation in the length of the spark gap, will soon enable the operator to obtain resonance. This point is indicated by the longest streamers. At its maximum efficiency the coil will send forth a spark that will dart a distance of more than five feet to a wire attached to the ground and brought near the discharge terminal. A strange feature of this experiment is the fact that the secondary cylinder is but 50 inches high and, rather than dart downwards, striking the primary of the coil, the spark will break down a far greater distance in a horizontal plane and still farther if the ground connection is placed overhead. This is a peculiarity of high frequency discharges.

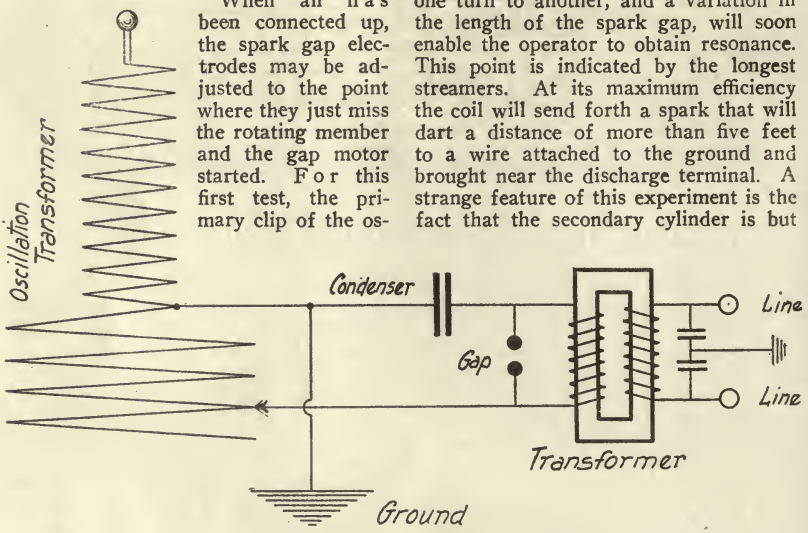


Diagram of Connections of the Apparatus

NEW BUSHING FOR BX

The Code requires that the armor of cables be fastened in outlet boxes, junction boxes and cabinets so as to secure good electrical connections. A new connector for BX, called the Jiffy bushing, is designed to do this. Metal fingers turned back from the bushing are compressed in the hole when the outside combination lock nut and spring washer are set tight with a pair of pliers, forming a secure connection.

A recent invention is in the form of an electrically-operated camera that may be used for photographing oil wells. When tools become broken the camera may be lowered into the well and a photograph obtained of the extent of the damage.

Practical Electro Therapy

Edited by Thomas Stanley Curtis

A Summary of Previous Articles

IT is intended in this number to give a general summary of the ground covered in the past five issues of the magazine; this summary serving as an introduction to the series which is to follow. In treating this subject, the reader is assumed to be a layman who knows next to nothing of electricity and its applications. For this reason, the author has attempted to make clear the nature of the various currents used in electro therapy and as simply as possible to show how they are applied, before taking up the real work of the department which will be to show the inner workings of electro-medical apparatus that is now on the market and in the offices of physicians throughout the country, if not the world.

It is believed that the average physician will obtain better results and greater satisfaction from his apparatus if he knows the why and wherefore of it; how it works; why certain things happen; where breakdowns are likely to occur and, what is more important, not so much how to repair such breakdowns but how to prevent them through intelligent handling. This knowledge will bring with it a feeling of confidence that is sure to be transmitted to the patient during treatment and if there is anything in the psychological effect in the practise of medicine, this is a point not to be overlooked.

We have learned that there are two primary forms of electric current; the direct, which flows in but one direction through a conductor; and the alternating, which flows first in one direction and then in the reverse, alternating its direction of flow perhaps many times a second.

We have seen that both alternating and direct currents may be retarded in their flow by means of resistance; this resistance acting as a valve in a pipe, cutting off the flow in proportion to the size of its opening.

We have learned that the direct current may be of two varieties: one the continuously flowing current that never fluctuates in its strength or value from one second to another, while the second form of direct current is known as a pulsating current. This current, while it flows always in one direction, changes its value or strength periodically perhaps many times a second, thus giving it a wavy or pulsating form.

The alternating current, we have seen, may be of two varieties known as the high frequency and the low frequency current. The term frequency referring to the periodicity or number of complete reversals of the current per second. This frequency is stated in terms of so many cycles per second.

We have learned that the pressure of the electric current is designated by the term *volt* while its volume is known in terms of *amperes*. The resistance to the flow of current is measured in *ohms*.

We have seen that the alternating and the pulsating direct types of current have the peculiar property of inducing a sympathetic current in wires in close proximity to those in which the fluctuating current may be flowing and further that this property, known by the term induction, is utilized in many ways In

(*Continued on page 263*)

High Frequency Current Scores a Success

Interesting Results Obtained by an Experimenter in the Miami River Valley.

A MOST interesting report on electro-culture experiments was made recently by Mr. T. C. Martin at a convention of electrical men and from this report it may be deduced that, of all the processes by means of which plant life may be stimulated, the one employing the high frequency current as its fundamental principle is the most successful by far.

The experiments mentioned by Mr. Martin were carried out at the Moraine Farm, a few miles south of Dayton, Ohio, and located in the celebrated Miami River Valley. The experiments were promoted by F. M. Tait, formerly president of the National Electric Lamp Association, and were in the immediate charge of Dr. Herbert G. Dorsey, whose work in this line has long been worthy of note.

In preliminary tests, according to Mr. Martin's report, says *The Philadelphia Inquirer,* small plots were marked off for exposure to different kinds of electrification. To insure that the soil of one plot was not better than that of another, top earth was collected, mixed and sifted and then was laid to the uniform depth of seven inches over the entire area. To quote further:

> In the soil of Plot No. 1 was buried a wire screen. Over the plot was a network of wire, stretched about 15 inches from the ground. Connecting the network above the ground and the screen below were several wire antenna. The screen was connected to one terminal of a Tesla coil and the network to the other. A transformer stepped a 110-volt alternating current up to 5,000 volts, charging a condenser of tinfoil and glass plates, which discharged through a primary of the coil. About 130 atts were operated for an hour each morning and evening.
>
> Plot No. 2 was illuminated by a 100-watt tungsten lamp with a ruby bulb. The light was turned on for three hours daily beginning at sundown. Plot No. 3 was illuminated the same way, except that a mercury vapor lamp was used. No. 4 had no artificial stimulation of any kind, being intended as a comparison between electrically excited plant growth and that of natural conditions.
>
> In Plot No. 5 was buried a wire network connected to the terminal of a 110-volt direct current. The positive terminal was attached to a small sprinkling can with a carbon electrode in its center. The can being filled, the water was subjected to electrolysis for several minutes. The plot was then sprinkled from the can, the theory being that the current might flow from the can, through the streams of water to the soil.
>
> Plots Nos. 6 and 7 were sub-divided into four individual boxes, two feet square, separated by porcelain insulators and arranged with carbon electrodes at each end. To these electrodes were applied both direct and alternating currents.
>
> After radish and lettuce seed had been planted and germination had begun, the various methods of electrification were tried with extreme care. The result of the experiments showed that the plants in Plot No. 1 grew in every instance far more rapidly than those in the other beds and more than double the normal growth as shown in the unelectrified bed.

The comparative results obtained with the various processes may be noted in the table which follows, and it is interesting to observe that the high frequency current from the Tesla coil takes the lead from the standpoint of weight of the edible portion of both radishes and lettuce grown under its influence:

Radishes (ten plants selected at random):	Plot 1 Telsa Coil	Plot 2 Ruby Light	Plot 3 Mercury Vapor	Plot 4 Normal	Plot 5 Elec. Spkg.
Total plant weight, grams	265.70	137.80	109.50	180.00	78.50
Edible portion, grams	139.50	57.40	40.90	79.40	31.00
Edible portion, per cent	51.15	41.65	37.34	44.11	39.49
Tops and leaves, grams	120.50	75.70	65.90	95.00	41.50
Tops and leaves, per cent	43.35	54.92	60.18	52.77	55.66
Roots, grams	9.30	4.70	3.20	5.60	6.00
Roots, per cent	3.50	3.43	2.48	3.12	4.85
Lettuce (ten plants selected at random)	67.00	52.60	56.60	46.10	31.30
Edible portion, grams	60.70	57.30	50.20	41.80	28.20
Edible portion, per cent	90.59	89.92	88.85	90.67	92.10
Roots, grams	6.30	5.30	6.30	4.30	3.10
Roots, per cent	9.41	10.08	11.15	9.33	7.99

Encouraged by these preliminary experiments, the workers started the research on a larger scale with a two-acre plot of ground. The details of the layout and an outline of the apparatus used will be reported in the March issue of MODERN MECHANICS. Following this report, the complete specifications for the construction of high frequency apparatus suitable for the cultivation of a two-acre plot will be given in order that interested readers may conduct similar experiments should they be interested to that extent in this subject.

THE HAMILTON RADIO ASSOCIATION

The Hamilton Radio Association held its first meeting on December 1st. One of the features of the meeting was the election of officers, as follows: President, Hughes Beeler; vice-president, Arthur Letherby; secretary, S. D. Doron; treasurer, Cecil Hopkins, and chief operator, S. W. Doron.

Plans for the ensuing year were discussed and many important suggestions were offered. At this meeting 30 members were present and it was reported that the number of stations of members in operation totaled 41.

It is said that the Hamilton Radio Association has the most powerful station in that section of the country, at their disposal. The range is well over 500 miles. The average power of other stations in the city is ¼ kw.

The association will be pleased to hear from other clubs and organizations interested in radio communication. All correspondence should be addressed to the secretary at 329 N. C. street, Hamilton, Ohio.

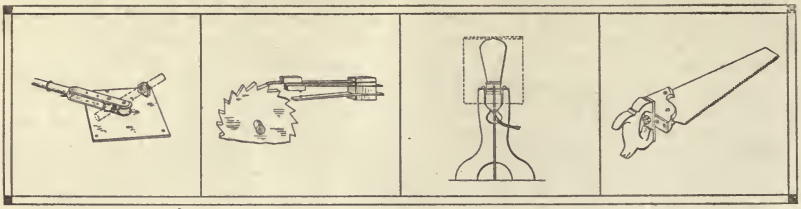
SUMMARY OF PREVIOUS ARTICLES

(*Continued from page 261*)

the application of the electric current.

Having covered this ground, it is felt that even the lay reader will be prepared to study the internal construction of a modern piece of electro-medical apparatus with an appreciable degree of intelligence, particularly if he has operated the machine (as so many physicians have) without making even a pretense of getting at the fundamental principles of the apparatus.

To this end, therefore, the next instalment will be the first of a series analyzing the various parts of machines of this nature.



Recent Novel Patents

Pipe Bending Device

A Chicago inventor has secured a patent on a pipe bending device that is shown in the accompanying illustration and which is strikingly simple. It consists of a long arm mounting at one end two grooved rollers that serve to bend the pipe which is held by an upright through which it passes.

Contact Making Mechanism

A member of an electrical manufacturing company of Chicago has been successful in obtaining a patent on a very simple contact making device that is illustrated in one of the accompanying sketches. His invention consists of a rotating ratchet the teeth of which alternately raise and lower a spring carrying a contact point that makes connection with another contact point mounted on a spring below.

Electric Lamp Stand

The latest in electric lamp stands is probably presented in the invention of a Rhode Island native. The invention covers a simple sheet metal stand that is made by interlocking two members at right angles. Obviously, the stand can be taken apart and packed flat for transportation purposes. In the upper portion of this stand a collar arrangement permits of inserting a standard lamp socket. An electric bulb and some suitable shade completes this rather inexpensive yet efficient lamp.

Improved Saw Handle

By using the newly invented saw handle patented by a Californian, greater use and convenience will be had from the usual saw than at the present time. This invention is quite simple, comprising the usual wooden handle on which is fastened by means of a pivot a clamping member for holding the saw proper. The saw can be turned at any angle in relation to the handle, which will be found very convenient in actual work.

Eyeglasses

A Western inventor has secured a patent for eyeglasses of entirely new design as regards the method of holding the lenses in place. As will be seen in the sketch, the lenses are held before the eyes by a simple framework that is attached to a band fitting around the wearer's head. The main advantage gained with this peculiar frame is that the nose of the wearer does not become sore as in the usual eyeglasses, while another feature is that the field of vision is not disturbed by portions of the mounting.

Cow Tail Holder

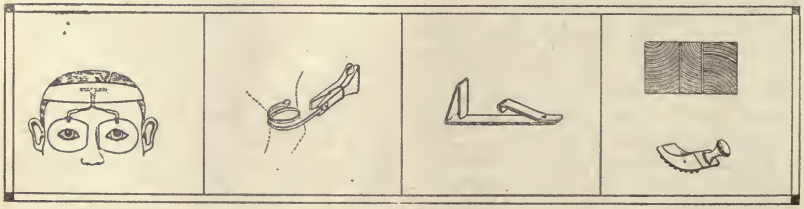
A Middle Western inventor has patented the simple device shown in one of the sketches for holding a cow's tail secure during milking time. This device consists simply of a steel spring portion which coils about one of the hind legs of the cow and which holds in place a spring clamp holding the tail. While inexpensive, this simple device would probably pay for its cost several times over in a short time by preventing the overturning of milk pails and the loss of their contents.

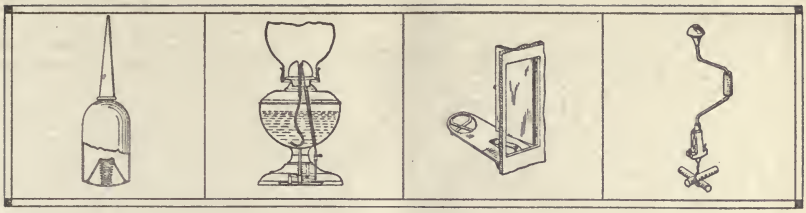
Simple Door Buffer

The subject of a recent invention is a simple door buffer that is shown in one of the accompanying drawings. It consists of a metal strip bent in the shape indicated. The buffer is fastened on any floor in such a position as to engage with a door when the latter is thrown open. Not only does the device break the force with which the door is moved, but it also locks the door in position to prevent its undesired closing. A pressure of the foot on the front portion releases the door when it is to be shut.

Wood Graining Tool

In one of the accompanying illustrations is shown a patented graining tool as well as specimens of its work. The tool carries a marking pad on its underside which is used in applying different grain markings on wooden surfaces.





Improved Oil Can

The improving of the usual type of oil can is the subject of a patent granted to an Iowan inventor. The improved oil can is fitted with a flexible bottom as in the instance of the conventional type, but in addition a powerful spiral spring is fitted within the can to return the bottom to its normal shape after it has been pressed. By employing this design it is possible to give the flexible bottom a greater contour and therefore facilitate the application of oil with such a can.

Automatic Lamp Extinguisher

Two Wisconsin inventors have joined forces in patenting a form of kerosene lamp that is automatically extinguished by simply raising it off the table or other support on which it may be placed. The extinguishing device is in the form of a sleeve sliding over the wick and connected to an arrangement in the base that pushes the sleeve upwards whenever the lamp is lifted. If the lamp is to be carried about a small lever on the side can be held to prevent the sleeve from moving upwards. The main advantage of using such a lamp is that the flame is immediately extinguished should it be upset accidentally.

Milk Bottle Holder

If the invention of two Philadelphians becomes widely employed, many persons who are in the habit of securing their milk supply free of charge will have to pay for this commodity in the future. The invention is in the form of a spring door, a ledge for holding the bottle, and the door frame which is mounted on the outside of a wall or door. As soon as the milkman places a bottle on the ledge of the holder, the door closes and the weight of the bottle actuates a member that locks the door securely. When the bottle is removed from inside, the door can again be opened from the outside.

Wire Twister

A New York inventor has secured patent rights on a simple attachment that may be used in connection with the ordinary brace for twisting wires, as shown in the sketch. The attachment consists of two jaws that firmly hold the ends of the wire. By turning the brace the wires are twisted more rapidly and firmly than would be possible by the use of pliers.

Umbrella Locks

A New York inventor has secured a patent on a hollow umbrella handle which contains a chain and padlock for securing the umbrella to any stationary object in order to prevent theft. When not in use the chain and padlock are placed in the handle and concealed by a pivoted cover as shown. The same idea is equally applicable to canes.

Attachment for T-Squares

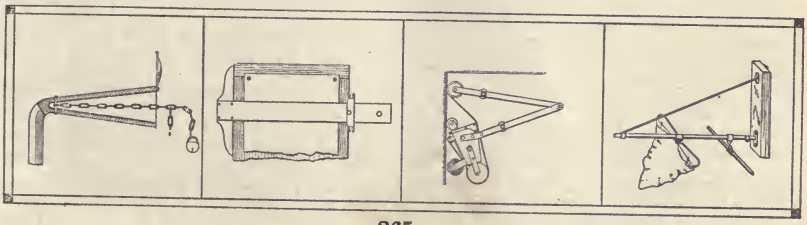
A Pennsylvania inventor has recently secured a patent for an attachment that may be fastened to any T-square and that serves to hold the end of the T-square firmly against the board and insure accurate work. A spring member as well as a clamping screw forms part of the attachment; the device being clamped at the desired place on the T-square while the spring firmly holds the T-square in place on the board. This device is quite simple and inexpensive to manufacture. Accordingly, it should have a very ready sale among draftsmen who will immediately appreciate its merits.

Wall Papering Machine

A rather ingenious machine has recently been patented by a Kansas inventor for use in applying wall paper directly from the roll to the wall with practically no manual labor. As seen in the illustration, the device consists essentially of a framework, a paste receptacle opening at its bottom to a roll over which passes the back of the wall paper fed from a roll, and lastly, a suitable cylinder for neatly pressing the paper in place. The invention is cleverly worked out.

Clothes Drier

A patent has just been granted to two New York inventors on a clothes drier of compact design. As shown in the illustration the drier is made in the form of a suitably supported rod on which other rods may be mounted so as to hold the great number of pieces hung up to dry. A simple wire framework can be fastened at any place along either rod and serves to hold the articles by means of ordinary clothes pins.



School of Practical Electricity

Under the title of "School of Practical Electricity, Vol. 1,"* five authors have contributed a very valuable work to students of electrical engineering. The book is divided into the following general sections: First principles of electricity, batteries and low potential electric wiring; theory of direct current; electric light wiring with problems; magnetism and the commercial applications of magnets; and telephony.

This work is written in a clear manner in order that it may be easily understood by the student, electrician, engineer, architect, and all those engaged in professions allied to the electrical industry. Countless diagrams and illustrations are employed to make the text explicit. Each section of the book is complete in itself and makes recourse to other works unnecessary.

**School of Practical Electricity*, Vol. 1, by Oscar Werwath, E.E., Principal of the School of Engineering of Milwaukee, George J. Kirchgasser, Frederick C. Raeth, Instructor in Chemistry and Electro-Chemistry in the School of Engineering of Milwaukee, and W. E. Hennig and R. A. W. Tamms, Instructor and Assistant, respectively, in the same school. Published by the Electroforce Publishing Company. Price, $4.50.

Art Work in Metal

"Art Metalwork" is the title of a recent addition to the many valuable works of The Manual Arts Press, covering the making, decorating and finishing of many diversified objects in metal. Beginning with a detailed description of the necessary tools and equipment to make the metal-craft objects described later in the book, the work leads the reader through chapters devoted to the designing of metalwork objects, copper and the alloys of copper, the various metal gauges in use, coloring and finishing of metal-craft work, sources of materials and equipment in which firm names are given where the necessary supplies may be secured, etching and soft soldering, straight bending and lapping, saw piercing, annealing, riveting, seaming, the making of beaten-ware, chasing, raising, hard soldering, enameling, spoon making, etc., etc. There are numerous objects described and illustrated as tasks for the reader to perform. And the most striking feature of the book* is that the author has endeavored to permit of using only the simplest and most common of tools and equipments for accomplishing the work.

** Art Metalwork*, by Arthur F. Payne. Published by The Manual Arts Press, Peoria, Ill. Contains 186 pages and 159 illustrations. Cloth bound. Price, $1.50.

Molded Insulation

A long-felt want in electrical engineering literature has been filled in a most satisfying manner by the publication of "Molded Electrical Insulations and Plastics."* The author evinces a thorough and practical working knowledge not only of the design and application of every form of molded insulator, but, what is perhaps even of greater importance, he offers a comprehensive discussion of the nature and chemical composition of the materials from which the insulators are made. Further, he possesses the rare gift of being able to impart highly technical knowledge in an understandable form which renders it of the greatest value to electrical engineer, designer and manufacturer alike. Reference to the trade names of the various compositions has been avoided and the aim has been to make the work a reference book of every conceivable form of data pertaining to the composition, design and application of molded insulation.

** Molded Electrical Insulations and Plastics.* Published by Ward Clausen Co., 200 Fifth Avenue, New York. Contains 207 pages and 86 illustrations. Cloth bound. Price, $8.00.

Electric Cooking, Heating and Cleaning

A volume very complete in every detail and dealing chiefly with the application of such electrically-operated appliances of use in the ordinary household as come chiefly under the sphere of woman's work, has been published under the title of "Electric Cooking, Heating and Cleaning."* It is the work of an English woman who writes with the enthusiasm of a possessor of an electric kitchen and a home that is fitted with electrical conveniences throughout.

Some of the subjects treated with great care and thoroughness are:

What electricity can do in the home; the commercial aspect of electric cooking; the duty of central station engineers; oven efficiencies; electric heating; ventilation and air purification.

The volume represents the first definite compilation of data relating to electric cooking in book form and will be of interest not only to the housewife but also to the central station engineer.

** Electric Cooking, Heating and Cleaning*, by Maud Lancaster. Published by D. Van Nostrand Company, 23 Park Place, New York. Price, $1.50.

Questions and Answers

This department will appear regularly in MODERN MECHANICS, subject to the following regulations: The questions must be legibly written with typewriter or in ink, on one side of the sheet. Each question must be definite and cover but one point of the subject under consideration, although a letter can contain more than one question. On the 10th of the second month preceding the date of issue of the magazine, all the questions on hand will be considered and those which are put in the most intelligent manner and of widest general interest will be selected for publication in such issue, the number being governed by the space available. All other questions will be returned to the writers with a statement of the price for which they will be answered by letter. Return postage must be enclosed with each letter containing questions, and the letters must be addressed to the Questions and Answers Department and contain nothing relative to other departments of the magazine.

AERIAL.

(8) R. J., Indianapolis, Ind., writes:

Q. 1.—I am about to put up an aerial on my house in West Indianapolis, but this is the lowest part of the city. It is flat, but still it is much lower than the rest of the city. Can I get as good results with my set as I could if I placed the same aerial up on a house on the higher part of the city?

A. 1.—As the waves follow the surface of the earth you will not be greatly hampered by being on the low ground since it is flat. If you were behind a high hill you would probably notice a decrease in your range due to the screening effect of the hill. However, since you are on flat, open land, you will probably not experience any great difficulty in covering ranges which will compare with those of the stations more favorably situated.

TRANSFORMER SUPPLY.

(9) E. W. M., New Orleans, La., asks:

Q. 1.—I have 220 volt, three-phase alternating current supplying a motor. I would like to operate a transformer for wireless work from this line. Is there any way I can do it other than by using resistance? I would, of course, only use one phase.

A. 1.—There is no way which will enable you to directly connect your transformer to the three-phase system. The best procedure for you to follow would be to construct a small closed core, 2 to 1 ratio auto transformer. Such a transformer could be constructed for a very small cost and little labor. The fact that you only have three-phase 220 volt supply should in no way hinder you from installing a radio set.

FUSES FOR BATTERIES.

(10) McC. R., O., asks:

Q. 1.—Are fuses made that will operate on battery currents?

A. 1.—Yes, such are regularly employed on common-battery telephone switchboards. Of course, on storage battery circuits fuses have to be of dimensions quite similar to those for dynamo machines.

Q. 2.—Are fuses practicable for induction coil secondary circuits?

A. 2.—No, the currents from such sources are altogether too small to affect even the smallest capacity fuses.

COPPER IN SUBMARINE CABLES.

(11) J. W. H., Melrose, Mass., asks:

Q. 1.—Does the copper of submarine cables crystallize the same as that in trolley wires?

A. 1.—No, for the cause of crystallization of the copper in the latter is due to the frequent bending, as every trolley wheel raises and lowers it. You can bend a copper wire a good many times before it will break, but thousands, or hundreds of thousands of bendings will eventually result in a crack and subsequent break. No mechanical action whatever can be discovered as attributable to the simple passage of the electric current.

Q. 2.—How many messages at a time can be sent over a telegraph wire?

A. 2.—The common working of trunk lines between important cities is on the duplex system, whereby two messages at a time are being sent, one operator at each end of the line sending and another receiving, four operators thereby being engaged, each quite oblivious that he has not exclusive use of the wire. Quadruplex sets of instruments are also largely in use, whereby four messages are being simultaneously sent, two from each end, eight operators thereby being served by one wire. Of course, there is only a single current passing over the wire at a given instant, but this current may be strong or weak, and in one direction or the other, and only certain instruments respond to certain connections.

EDISON BATTERIES.

(12) M. R. P., Seaford, Del., asks:

Q. 1.—How to set up an Edison primary battery.

A. 1.—Since the excitant of this type of

battery is caustic soda, a first direction will be to keep the fingers out of it. A saturated solution of the caustic is made and placed in the jar. A layer of heavy paraffin oil, say ¼" or more in depth, is then poured on top the solution. This is to keep the water from evaporating and the salts from crystallizing out. Before immersing the copper oxide positive and the zinc negative plates, wet them. This precaution is merely to prevent the oil from adhering to them in passage.

Q. 2.—What voltage should one of the batteries give?

A. 2.—On open circuit—when no current is being taken—the voltage should be .95, but when supplying normal current the voltage will fall to about .70.

RADIO LICENSE AND EMPLOYMENT.

(13) K. B. R., Waltham, Mass., asks:

Q. 1.—Is an applicant for a commercial radio license obliged to secure an amateur license first?

Q. 2.—How would you advise a boy 15 years old to secure a commercial license; said boy being able to operate all instruments, receive and send at a moderate speed, and having a pretty good knowledge of the theory, wavelengths, etc.?

Q. 3.—How could the same boy, after securing commercial license, obtain employment by the Marconi Co. to work summers?

A.—The above questions are typical of a large number of questions continually being asked us by our readers and it seems advisable here to make the answers more complete than is usually permissible. In this manner we hope to reply in a general way to all questions asked on the subject.

The first step an applicant for any form of radio license should take is to send fifteen cents to the Superintendent of Documents, Government Printing Office, Washington, D. C., and obtain the bulletin entitled "Radio Communication Laws of the U. S." This is a recent publication containing the U. S. radio laws, the international radiotelegraphic convention, together with a liberal interpretation of their meaning and details regarding application for licenses.

Any citizen of the United States may apply for examination for a commercial radio license. He is not required to have had any previous training or to hold any other form of radio license. In the examination, however, 20 per cent. is allowed for previous experience and as 75 per cent. is required to qualify for a first grade license, the applicant must be unusually well trained to qualify if he has not had some previous experience. The holding of an amateur license will receive its credit if the holder has a good record as an amateur operator. Only 65 per cent. is required to qualify for a second grade operator.

The examination consists of questions regarding the regulations relating to radio communication, the adjustment and operation of radio apparatus, the use and care of a storage battery or other auxiliary, and the passing of a speed test. The speed test consists of copying signals from an omnigraph at the rate of 100 characters per minute. The signals do not consist of a complete message, but, instead, of disconnected words, abbreviations, numerals and punctuation marks. There is very little chance for a poor operator to bluff the speed test. The applicant is, however, given five chances in that the omnigraph is run for five minutes while the applicant is required to copy only any 100 consecutive characters. Failing to pass disqualifies the applicant for three months from again applying for an examination.

After obtaining a license the possibility of securing employment will depend on the demand for operators. Application should be made to the local office of the company you desire to work for. If the local manager considers you as sufficiently qualified your name will be placed on file and when your turn comes you will be given employment. In general there are more applicants than positions, so that it is usually necessary to wait considerable time before securing a berth. In your district during the past summer there were applicants who did not receive a single assignment, and others who made but two or three trips. Summer operating appears very attractive; so it is; but one should have patience if he expects to get a good berth.

MOTOR WINDING.

(14) E. M. D., Bellingham, Wash., asks:

Q. 1.—How can I change a 3-phase, 220-volt, 20-h.p. motor so as to permit its operation on 440 volts? There are eight poles, with four coils per pole per phase, making 96 coils in all.

A. 1.—It is common practice for manufacturers to group all the coils that produce an instantaneous North pole in one circuit, and those that produce an instantaneous South pole in another circuit. Then, in a 3-phase motor, there would be the possibility of following out six different circuits. Now if you put each of these North and South pole circuits in parallel, you can get an arrangement that may be right for 220 volts, but if you connect them in series they will be right for 440 volts. Perhaps your motor has the 110-220 volt possibilities. You should write to the manufacturer, stating the serial number.

Q. 2.—How can the horse-power be figured from the readings of switchboard instruments, say in case of a three-phase system, with 800 amperes per phase, 480 volts across phases, power factor being .85?

A. 2.—Multiply the number of volts by the amperes and by the power factor and by the square root of three. or in your case 480 × 800 × .85 × 1.73. This will be 564,672 watts. Since there are 746 watts per horse-power, the result will be about 765 horse-power.

Q. 3.—How can the horse-power of an induction motor be found from the ammeter reading?

A. 3.—The use of an ammeter alone will not suffice for finding the power.

RADIO SECTION

Devoted to the Encouragement of Amateurs and Experimenters in the Field of Radio Communication.

Radio-Frequency Ammeters

By A. S. Blatterman, B. S.

THE circuit within a high-frequency ammeter must be of as simple form as possible. This requirement is best fulfilled by a single straight wire of very small diameter, and no other arrangement can be taken as a *priori* reliable at all frequencies. The heat production is readily measured in any form of circuit, and in consequence all successful ammeters for high-frequency use utilize the thermal effect. The way in which the heat production is measured, whether expansion, calorimetric effect, resistance or thermal e.m.f., does not affect the accuracy.

In a Bulletin of the Bureau of Standards dated Jan. 15, 1914, an account was given of a long experimental investigation of reliable ammeters for high-frequency work. It was found that two similar wires in parallel—the integrated heat production in the whole being measured—constituted a system nearly as reliable as a single wire. A great variety of ammeters were studied in this investigation. Experimental instruments and commercial instruments of three different companies were included, and it is interesting to note that all types were subject to errors when used at the frequencies of radio telegraphy. Some of the errors were very large. In some cases the readings increased with increase of frequency and in others they decreased, though in most cases it was found that the design could be so changed as to eliminate the errors.

The current in a conducting circuit has no meaning for extremely high frequencies, for in any circuit above a certain high frequency the capacity between different parts of the circuit and of auxilary apparatus is so important that an appreciable fraction of the current is shunted through the dielectric and the current is of different amount in different parts of the wire circuit. Thus the two metal terminals, usually binding-posts, to which the heating element is attached, mounted upon insulating pillars or in insulating bushings, virtually constitute a condenser through which an appreciable fraction of the total current may be shunted. Similarly, capacity currents may pass to the frame of the meter. With a sinusoidal e.m.f. E, at frequency n, the current through a capacity C is

$$i = 2 \pi n C E.$$

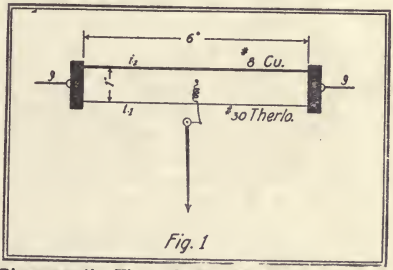
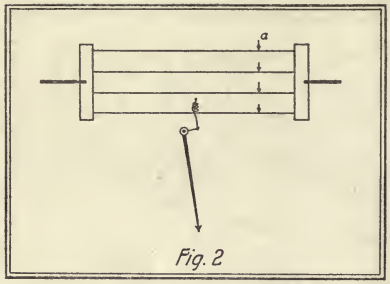


Fig. 1

Diagrammatic View of Hot Wire Ammeter and Shunt.



Diagrammatic View of Hot Wire Ammeter with Shunt as an Integral Part of the Instrument.

Obviously the capacity current may not be negligible at radio-telegraphic frequencies where "n" has a value from 100,000 to 1,500,000 cycles. The location of the current leads is of great importance.

Most of the errors of commonly used high-frequency ammeters are due to mutual inductances or self-inductance of parts, which are often supposed to be negligible. When the active element of a hot-wire ammeter is shunted by another wire the readings of the meter are no longer always dependable but will change with every change in the frequency. Thus, the readings of a meter having for its active element a No. 30 Therlo wire and a shunt of No. 8 copper wire, will increase with increase in frequency and decrease when the frequency is lowered. That is, for short wavelengths the correction factor for the shunt is smaller than it is for long wavelengths; which simply means that at short waves less current passes through the shunt and more of it through the active wire than when long waves are used.

At high frequencies the current density in a conductor is not uniform throughout its cross-section but is greatest near the surface. This "skin" effect is very noticeable in heavy wires; but in wires of small diameter it is not so marked, and in very thin wires is negligible. This, however, does not completely explain the change in the value of the heavy wire shunt mentioned above with change in frequency. Besides the changes in resistance, the effects of self and mutual induction are highly important. As an example, let us take the case cited above of an ammeter having a No. 30 Therlo wire shunted by a No. 8 copper wire, and calculate the ratio of the currents in the two wires. Let each of these wires be six inches in length and let them be mounted parallel to each other 1 inch apart. (See Fig. 1.)

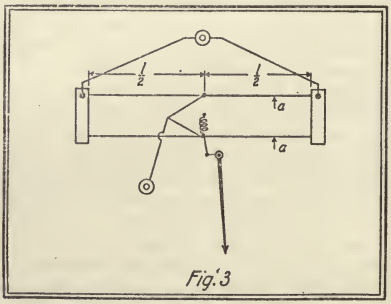
It can be shown that in a divided circuit like that under consideration the ratio of the currents in the branches is given by

$$\frac{i_1}{i_2} = \sqrt{\frac{R_2^2 + \infty^2 (L_2 + M)^2}{R_1^2 + \infty^2 (L_1 + M)^2}} \quad \ldots (1)$$

where

R_1 = resistance of wire No. 1 (No. 30 Therlo in this case)
L_1 = inductance of wire No. 1 (No. 30 Therlo in this case)
R_2 = resistance of wire No. 2 (No. 8 copper in this case)
L_2 = inductance of wire No. 2 (No. 8 copper in this case)
i_1 = current in wire No. 1
i_2 = current in wire No. 2
M = mutual inductance of wires
$\infty = 2\pi n$ where n = frequency.

Let us first calculate the value of the ratio $\frac{i_1}{i_2}$ for a working wavelength of 300 meters and then, in order to see the effect of changing frequency, for a wavelength of 900 meters, and for direct



Another Method of Constructing Hot Wire Ammeter with Self Contained Shunt.

current. The calculated values for substitution in the equation are

for $\lambda = 300$ m.
$R_1 = 1.4$ ohms
$R_2 = 0.004$ ohms
$L_1 = 206.8 \times 10^{-9}$ hen.
$L_2 = 129 \times 10^{-9}$ hen.
$M = 65.72 \times 10^{-9}$ hen.
$\omega = 6.283 \times 10^6$
for $\lambda = 900$ m.
$R_1 = 1.4$ ohms
$R_2 = 0.00234$ ohms
$L_1 = 206.8 \times 10^{-9}$ hen.
$L_2 = 129 \times 10^{-9}$ hen.
$M = 65.72 \times 10^{-9}$ hen.
$\omega = 2.094 \times 10^6$

which gives for the 300 m. wavelength

$$\frac{i_1}{i_2} = \sqrt{\frac{0.004^2 + 6.283^2 \times 10^{12} (129 + 65.72)^2 \, 10^{-18}}{1.4^2 + 6.283^2 \times 10^{12} (206.8 + 65.72)^2 \, 10^{-18}}} = 0.553$$

and for the 900 m. wavelength

$$\frac{i_1}{i_2} = \sqrt{\frac{0.004^2 + 2.094^2 \times 10^{12} (129 + 65.72)^2 \, 10^{-18}}{1.4^2 + 2.094^2 \times 10^{12} (206.8 + 65.72)^2 \, 10^{-18}}} = 0.2695$$

If direct current were passed through this instrument the currents in the wires would be in inverse proportion to their *resistances* only and the inductance would be of no importance. Thus for direct currents the ratio i_1/i_2 is

$$\frac{i_1}{i_2} = \frac{R_2}{R_1} = \frac{0.0003142}{1.4} = 0.000224$$

Now the multiplying value of the shunt, *i. e.*, the *number* which must be used to multiply the readings of the meter (given by the expansion of the fine wire) to obtain the actual value of the current in the circuit in which the meter is connected, may be defined as the ratio of the actual current in the circuit, I, to the current passing through the fine wire, i_1; *i. e.*, by the ratio I/i_1. If the ratio i_1/i_2 which was calculated above for three special cases be denoted by k, then the multiplying factor for the shunt is given by

$$F = I/i_1 = \frac{k + 1}{k}$$

To take the above example this correction factor for the shunt comes out in the three cases considered

$$F_{300} = \frac{1.553}{.553} = 2.81 \text{ for wavelength} = 300 \text{ m.}$$

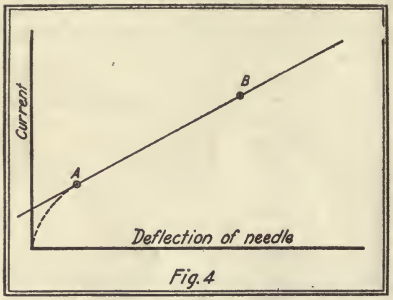
$$F_{900} = \frac{1.2695}{.2695} = 4.71 \text{ for wavelength} = 900 \text{ m.}$$

$$F_{dc} = \frac{1.0000}{.000224} = 4460 \text{ for direct current}$$

The great error which is committed by using a meter like the one under discussion to measure currents at frequencies other than that for which it was calibrated is apparent. In this particular case, if the meter were calibrated at 900 meters and then used in a circuit with wavelenth 300 meters, the readings would all be

$$\frac{4.71}{2.81} = 1.68 \text{ times too high.}$$

When a meter is used at radio-frequencies with an external shunt the correction factor for the shunt must be determined for each wavelength. The simplest way of doing this is to connect a like unshunted meter in the circuit in series with the regular instrument and use reduced power so that the needle of the unshunted meter just remains on the scale. The ratio of the readings of the two meters then gives the multiplying value for the given frequency. Where only one meter is available a good approximate calibration may be obtained by using reduced power and observing the reading of the meter without the shunt and then with the shunt connected.



Calibration Curve of Hot Wire Ammeter Using Therlo Wire.

But if thereafter the wavelength be changed a new calibration must be made.

In constructing meters for current value where a single fine wire will not suffice to carry the total current, then the shunt should be built into the instrument. It is possible to build such a shunt so that the meter will, for all practical purposes, read accurately at all frequencies and can even be calibrated with direct current. Two constructions which give satisfactory results are shown in Figs. 2 and 3.

The wires *a* are all of the same material and cross-section, and of equal lengths, and are fastened to heavy copper terminal blocks. Only one of the wires takes part in the indication of the instrument; the others are shunts. Since the inductance and resistance of all of the wires are practically equal, they all carry practically the same currents, hence have the same temperature, and thus the shunt ratio is independent of the current strength. Likewise, because the impedance of each path is the same, the indications are independent of frequency. Thus the instrument may be calibrated with direct current and used thereafter in radio-telegraph circuits without appreciable error. The indicating and shunt wires should be of small diameter (No. 30 or finer) to reduce the skin effect as much as possible. What little skin effect then remains produces no effect on the shunt ratio, although it does slightly affect the sensibility of the ammeter as a whole.

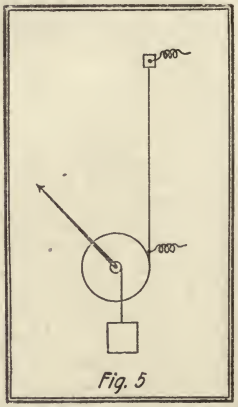
An objectionable feature of some hot-wire meters now in use is the non-linear scale. With such a scale the accuracy in reading cannot be the same for all current values. By suitably choosing the material of the indicating (and shunt) wires the scale can be made to be practically linear, except for a very small region near the zero. The wire for this purpose should have

1st, a practically constant resistance for all frequencies and temperatures up to about 300 or 400 degrees; that is, its temperature coefficient should be small.

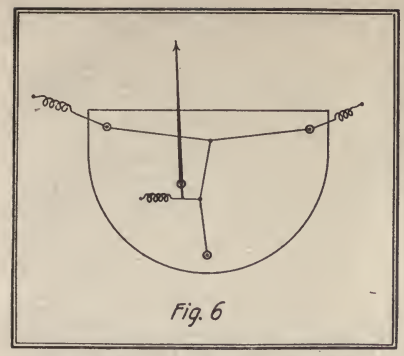
2nd, its coefficient of expansion should be constant within the same temperature range.

"Therlo," which is a patented alloy of copper, manganese, and aluminum, makes an excellent wire for hot-wire ammeters. Its temperature coefficient is 0.0000031 per degree F. and practically constant. Thus the resistance of this wire is practically independent of temperature. The temperature coefficient of copper varies with the temperature all the way from 0.00215 to 0.0042, which is quite high. A copper wire does not give a uniform scale. The expansion coefficient of "therlo" is undetermined as far as the writer knows, but experiment indicates that it is very likely constant.

If Therlo wire forms the heating element (and shunts) of the meter the calibration curve will have the characteristics of that shown in Fig. 4; and the calibration can be quickly effected by obtaining two points on the curve such as A and B and connecting them by a straight line. The current corresponding to any deflection of the needle



Scheme for Transmitting Linear Expansion of Wire to Indicating Pointer.



Principle of Hot Wire Ammeter that Takes Advantage of the Sag in the Wire.

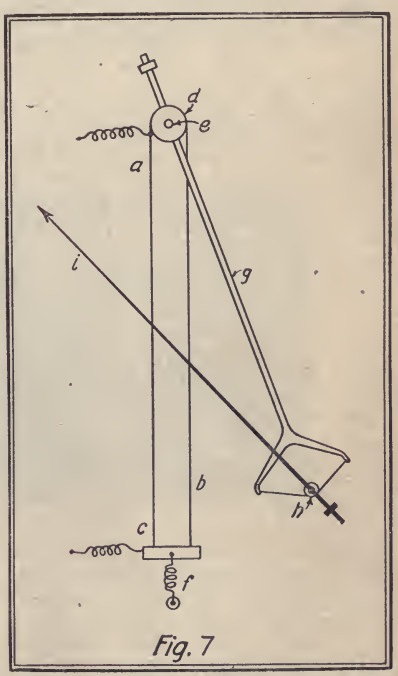
can then be read off directly.

There are two general methods of transmitting the linear expansion of the wire to the indicating pointer. The first method (Fig. 5) makes use of the change in length of the wire directly. This necessitates a long wire in order to produce an appreciable deflection of the pointer which forces an ungainly form on the instrument and aggravates errors due to changes in the temperature of the atmosphere. It is much better to make use of the sag of the wire, since for a given wire the sag is greater than the expansion* and hence it is possible to secure a larger deflection.

One construction which takes advantage of the sag rather than the direct expansion is shown in Fig. 6. The plate upon which the wires are mounted should have the same temperature coefficient of expansion as the wires so as to reduce errors due to changes in the temperature of the air. Means should be provided for the adjustment of the zero; and in this connection it is hardly necessary to say that this adjustment should not be made by shortening the wire, as for instance, by wrapping it up on the spindle of a thumb-nut. Such a procedure changes the resistance of the wire and the readings are no longer accurate.

The Whitney hot-wire ammeter employs an ingenious method for the compensation of temperature changes. Referring to Fig. 7, a wire *a b* of uniform cross section is strung from the plate *c* around the pulley *d*, back to the plate *c* and held taut by the spring *f*. The wire is insulated at one side of the plate so that only the *a* side of the loop forms a part of the electric circuit. Temperature changes in the atmosphere affect both sides of the loop and result in simple expansion and contraction, which is taken up entirely by the spring *f*. The *a* side of the loop carries the current to be measured and becomes heated thereby. The resulting expansion of this side of the loop produces rotation of the pulley *d* which is communicated to the arm *g*, and by means of a small cord about the pulley *h*, the pointer *i* is made to swing over the scale of the instrument. The temperature compensation afforded by this method is practically perfect.

In conclusion it may be said that what-



Principle of Hot Wire Ammeter that Compensates Temperature Changes.

* Unless the wire is very short.

ever the type or form of the hot-wire ammeter, particular attention should be paid to the location of the leads and to the construction of the shunts. While linear scales are desirable and while temperature compensation and methods for zero adjustment are important, the effect of self and mutual inductance as well as skin resistance and capacity currents are so pronounced at the frequencies of radio telegraphy that unless the meter is properly constructed the gravest errors may be made in using meters in these circuits. It is easy to build meters which are independent of frequency, and instruments which are not free from the effects of frequency can be easily calibrated for the particular circuit in which they are placed. A full appreciation of the facts outlined above should demonstrate the importance of these conclusions.

NAVY TYPE AUDION RECEIVING SET

A VERY elaborate and highly efficient navy type audion receiving set has recently been brought out by an American manufacturer of wireless apparatus, of Pottstown, Pa. This set, which is illustrated in the accompanying view, is known as the "Radio Transcontinental" and is licensed under the DeForest audion patents for private use.

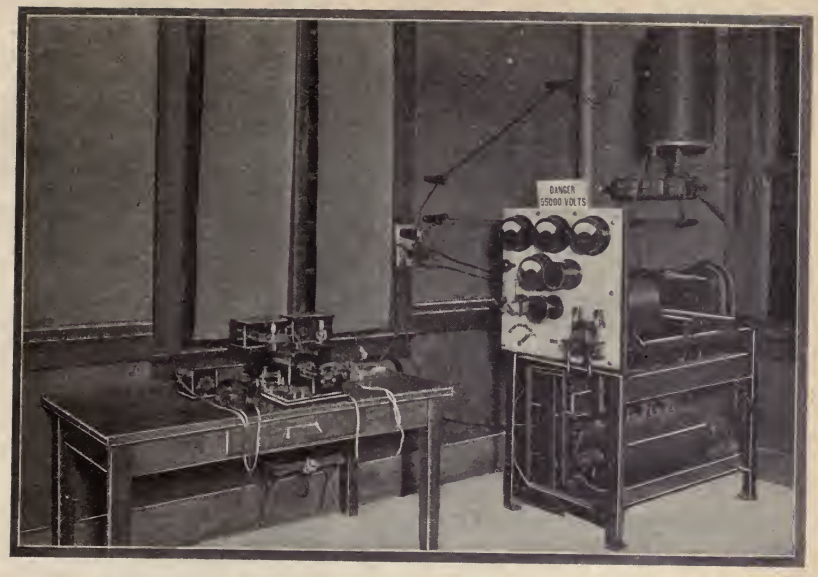
The set contains two super-sensitive audions, a 7,000 metre receiving transformer with dead end dividing chor gap. The entire set is mounted on a hard rubber panel which forms the front of an attractive cabinet.

The selectivity of the "Radio Transcontinental" set is said to be unsurpassed and interference has been reduced to a minimum. The set is designed for use in connection with a transmitting break-in system, thus eliminating the necessity of an aerial switch. The life of the batteries in the telephone circuit varies from two to three years with ordinary use.

An Elaborate Audion Receiving Set with Many Refinements.

switches, a primary condenser that may be inserted in series or parallel to the transformer primary, a secondary condenser, a voltmeter that may be used for measuring the voltage supplied to the audion filaments and telephone receivers, a rheostat and an an-

This set is especially adapted for jewelers desiring to receive time signals over great distances. A distance of 2,500 miles will not prevent the user of this set from receiving time signals from the Arlington station. Greater distances can be covered with larger aerials.



In the accompanying illustration is shown the wireless station installed in the factory of the Illinois Watch Company at Springfield, Ill. The transmitting apparatus is employed for sending time signals to jewelers at 12 o'clock noon and 8 o'clock in the evening, Central Time. The time signals begin five minutes before the hour and the same system is used as that of the Arlington time service.

The transmitting set consists of a 10 KW transformer supplied with 220 volt, 60 cycle alternating current. Glass plate condensers are used, consisting of 60 separate units arranged in three banks. The spark gap is of the rotary quenched type driven by a motor.

The signals emitted by this apparatus are not of a high pitch, owing to the low frequency of the current supplied. However, they appear to possess good carrying quality inasmuch as the signals have been heard upwards of one thousand miles. The wave length of the time signals from this station is 2,000 metres, which is considered efficient, as well as producing the minimum of interference with commercial work.

WIRELESS OPERATOR PRAISED BY SECRETARY REDFIELD

Secretary William C. Redfield, of the Department of Commerce, has recently written a letter of praise to L. A. Lovejoy, former operator on the wrecked steamship *Hanalei*. The letter follows:

December 14, 1914.

My dear Mr. Lovejoy:—

I have noted with personal and peculiar interest the record of your action on the occasion of the wreck of the steamship Hanalei on November 22.

There has come to be accepted in the public mind a very high standard of behavior on the part of wireless operators in times of danger. This has arisen from the uniformly fine behavior of such operators on such occasions. To this admirable rule your coolness and unselfish courage at the time of the wreck of the vessel on which you were employed form no exception.

You are specially to be commended for the ingenuity and persistence with which you maintained communication with the shore during the day and night following the wreck. It is no more than your due that this should be recognized and it is a pleasure to me so to do.

I indorse and approve your commendation of your assistant, Adolph J. Svenson, who showed a fine unselfishness throughout that trying time and who was lost.

Yours very truly,

(Sig.) WILLIAM C. REDFIELD,
Secretary.

THE FALLACY OF THE FLAT TOP AERIAL

OF all antenna used in the transmission and reception of wireless signals, those of the inverted L and T types are almost universally employed among amateurs. Perhaps the two principal reasons for this are: (1) That these aerials are more easily erected than other types; (2) that would-be amateurs seeing that their wireless friends have all adopted these types of antennæ, arrive at the conclusion that these are the only designs that may be easily built and will give satisfactory results.

When regarded in the light of common sense, backed up by experiment, the flat top aerial is a very inefficient proposition.

The electromagnetic waves emitted from an aerial when a message is being sent radiate equally in all directions, or nearly so. But the waves that come into contact with the receiving antennæ travel parallel to the ground and come from one direction only; if it be true that they do pass around the earth and reach the aerial from the other side, they are too weak to record themselves in the receiver. If, then, a wave is traveling parallel to the ground from a point nearly at right angles to the aerial, it is logical to believe that the wave first comes in contact with one of the two outside wires. When it strikes that wire, most of the energy contained in this particular section of the wave is absorbed by the wire and carried by the lead-in to the instruments. The other wires merely serve to absorb the smallest part of the wave that escapes the first wire. The proof of this statement lies in the following experiment:

Remove all the wires from a flat top aerial with the exception of a single strand and note to what extent the strength of received signals has diminished. One will be surprised to find but little difference in the signals received with the one wire aerial and the multi-wire flat top aerial.

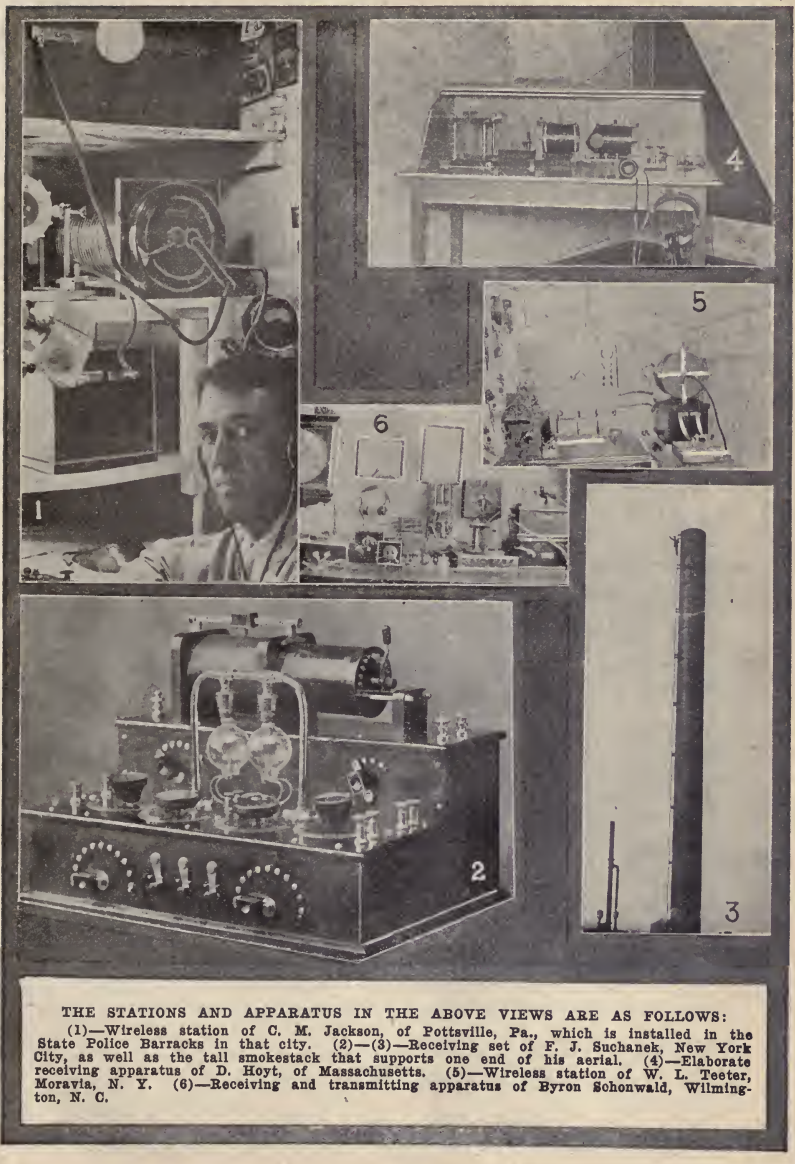
After one has convinced himself of the foregoing, the next step is to arrange the aerial as before with all the wires in place. Attach weights on one end of both spreaders so that the aerial when raised will turn at right angles to its former position, *i. e.*, the wires will be one above the other. On connecting to the receiving set the experimenter will be surprised to note the increased strength of the signals received. Every wire is now doing its full share of the work. The oncoming waves instead of having practically but one wire to intercept them now have from two to ten or as many as the experimenter wishes, placed one above the other, to gather the energy.

An aerial of the type just described may be as readily erected as any other and the results will certainly prove far more satisfactory. Heretofore, most amateurs have secured the maximum receiving efficiency by using a single long wire. However, the latter form of aerial is not always practicable and for this reason the type described in the foregoing may perhaps be of value to many.—JOHN C. CROWLEY.

RADIO-TELEPHONIC SERVICE BETWEEN LONDON AND NEW YORK

According to *Zeitschrift fur Schwachstromtechnic,* the Marconi Society of London is actually engaged in organizing a radio telephonic service between London and New York. In his wireless telephone experiments with the war vessels of the Italian fleet, stationed in Sicilian waters, M. Marconi has already had very striking success. The apparatus employed there has a radius of only 75 to 100 kilometers (45 to 60 miles), but there is good reason to believe that the greater distance between London and New York can be crossed without any insurmountable difficulty. The Marconi apparatus is very simple, and the sending and reception of the radio telephonic messages is as easy as with ordinary telephones.—J. H. BLAKEY.

AMATEUR WIRELESS STATIONS



THE STATIONS AND APPARATUS IN THE ABOVE VIEWS ARE AS FOLLOWS:

(1)—Wireless station of C. M. Jackson, of Pottsville, Pa., which is installed in the State Police Barracks in that city. (2)—(3)—Receiving set of F. J. Suchanek, New York City, as well as the tall smokestack that supports one end of his aerial. (4)—Elaborate receiving apparatus of D. Hoyt, of Massachusetts. (5)—Wireless station of W. L. Teeter, Moravia, N. Y. (6)—Receiving and transmitting apparatus of Byron Schonwald, Wilmington, N. C.

SUGGESTIONS FOR AMATEURS

HERE are a few suggestions for amateurs that may aid them in improving their sets:

In connecting a buzzer set it is a good plan to bring one lead from the contact post of the buzzer to one side of a telephone condenser. The other lead of the condenser is left free. The condenser will then act as a radiating aerial for the waves generated by the buzzer. This arrangement will be especially appreciated by amateurs who have connected their buzzer test set in the ordinary manner and have found that it can be heard plainly even when there is no detector in the circuit. This scheme of connection becomes almost a necessity when using galena for the reason that the ordinary buzzer test often burns out a sensitive contact point.

In calibrating a sending set with a wave meter, use the combination of iron pyrites and antimony for the wave meter detector. Such a detector will not burn out, even when used in close proximity to a powerful transmitter.

It is advisable to secure station and operator's licenses whether one is obliged to or not. It places the operator and his station in higher regard than if he did not possess these licenses.

In constructing wireless apparatus it is very important to employ careful and thorough workmanship. If the completed instrument fails to work, it is then evident that the principle and not the construction is at fault.

The Underwriters' regulations should be conformed with when installing a wireless station in order to avoid future possible trouble.

It is advisable to have a substantial, sturdy aerial rather than an exceptionally high one that is apt to be blown down by a strong wind.

In making one's own instruments the use of self-cleaning, knife-edge switches is recommended in preference to sliding contacts. In making a loose-coupler the secondary should be adjusted to slide freely and the connections from the secondary should be brought back through the primary tube by means of flexible conducting cord. The employment of the sliding rods for making connections with the secondary is discouraged. Many sets operate at half their efficiency because of carelessness in this particular.—P. W. CONRAD.

WIRELESS CLUBS—ATTENTION!

The Wireless Press, Ltd., Marconi House, Strand, London, W. C., England, is preparing the Year Book of Wireless Telegraphy and Telephony, and desires information concerning all wireless clubs in the United States. In the Year Book there regularly appears a directory of wireless societies and in order to compile the lists accurately the Wireless Press will be pleased to receive notices of changes in title or address which may have taken place during the past year, as well as the name and address of all new societies. The information must reach them before February 1st.

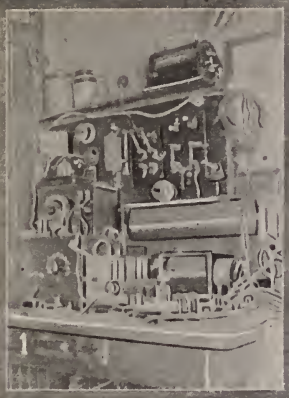
ENGINE SPARK COIL USED FOR COMMERCIAL WORK

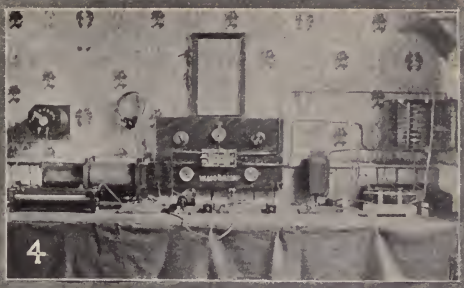
Radio Operator Robeson tells of an interesting application of an engine spark coil when the wireless set on board the U. S. S. *Essex* was not in working order. His story follows:

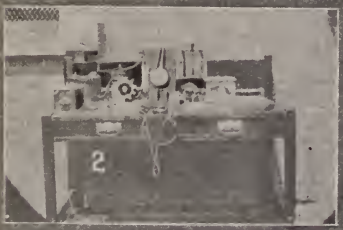
"While cruising about five miles off Bois Blanc in Lake Huron, Chief Operator Dow of the U. S. S. *Essex* received an important message from Mackinac for the gunboat *Luzon* which was then about two miles off Mackinac Island Beach and within signalling distance. The *Essex* having no auxiliary set and the generator being temporarily out of commission,

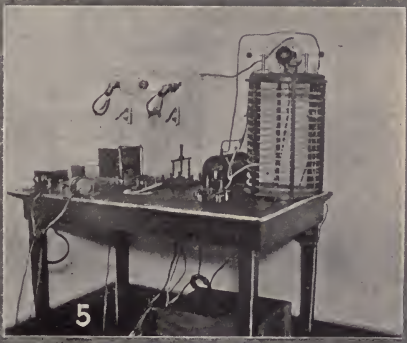
(*Continued over leaf*)

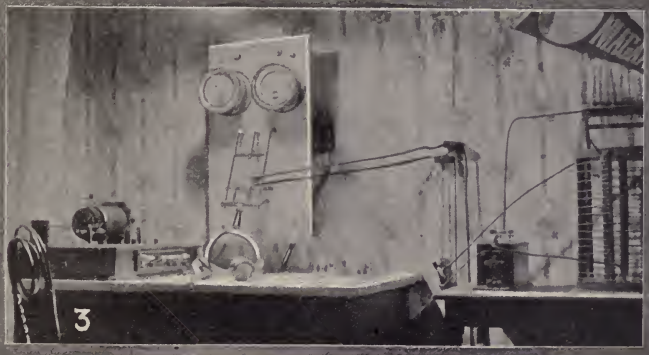
AMATEUR WIRELESS STATIONS











THE STATIONS AND APPARATUS IN THE ABOVE VIEWS ARE AS FOLLOWS:

(1)—Wireless station of Andrew G. Halpin, Brooklyn, N. Y. (2)—Wireless station of S. Candide, Brooklyn, N. Y. (3)—Receiving and transmitting set of Harry E. Frost, Buffalo, N. Y. (4)—Apparatus of W. Morrish, Gravenhurst, Ont., Canada. (5)—Wireless station of Wilmar Tims, Cleveland, O.

the operator resorted to the spark coil and storage battery from the power life boat which were connected to the ship's aerial without a condenser. When answers were received by flag from the *Luzon,* they were transmitted to the Mackinac Island station, which was about seven miles distant."

Not only is this incident a noteworthy accomplishment from the point of view of the low power employed, but it is also interesting because of the ingenuity displayed by the operator.

THE CANADIAN WIRELESS AMATEUR

While most wireless amateurs in the United States are now busily engaged in conducting experiments and communicating with each other, the amateurs in Canada are inactive because of the European war. Aerials of the Canadian amateurs have been ordered pulled down and all instruments have been sealed up by the police; the result being that the study of wireless telegraphy is at a standstill in that country. It is obvious that there will be a big rush to hoist aerials when peace is declared.

The present time can and should be used to advantage by Canadian amateurs. Although it is impossible to devote the time to the making of wireless apparatus for the reason that it would be confiscated, the interval of inactivity can serve to encourage the saving of a sufficient sum in order that the amateur can purchase reliable instruments at the conclusion of hostilities.

Another suggestion for Canadian amateurs just now is to form a relay society similar to that of the American Radio Relay League. If a similar organization existed in Canada it would be possible in normal times to transmit a message from the Atlantic to the Pacific through a chain of amateur stations. It is quite probable that if such a system had existed before the war, it would now be used by the authorities.

Lastly, the amateurs can use their time to good advantage by practicing with a buzzer set so as to become proficient in receiving.—W. J. Knipe.

AN IMPORTANT DECISION

On November 24th Judge Wellborn, of Los Angeles, fined an amateur for operating a radio station without a license. The defendant contended that because his apparatus has not been reported as interfering with commercial stations and because in his opinion he could not transmit beyond the boundaries of the state in which his station was located, his equipment did not require a license. The conviction was obtained on the ground that his station could interfere with interstate communication to licensed amateur stations in his vicinity.

This decision is an important one in view of the existing erroneous opinion among most amateurs that if a transmitter will not send signals over the boundary of their state, they are exempt from the requirements of the radio laws. Not only does the law state that an amateur must secure a license if his apparatus can transmit over state boundaries, but it also emphatically insists that a license should be obtained if the transmitter interferes with other stations in the state receiving from stations in other states.

THE LICENSED WIRELESS OPERATORS OF WESTERN NEW YORK

In a recent communication Mr. A. H. Benzee, Jr., Secretary of the Licensed Wireless Operators of Western New York, states that his society has never been disbanded as reported on previous occasions, nor has there ever existed any intention of doing so. The club is holding its meetings regularly. The constitution has been somewhat revised and a new form of application blank inaugurated. The secretary will be pleased to correspond with similar organizations.

Perfecting the Rotary Spark Gap

By A. L. Patstone

Here is an article entirely out of the ordinary. The author points to the fact that the reason why so many home-made wireless instruments fail to give the maximum efficiency is because simple, fundamental principles of electricity and mechanics are ignored. Taking a rotary spark gap as an example, he discloses how the construction should be worked out in order to secure the most efficient results in the finished apparatus.—THE EDITOR.

VISITING a number of amateur radio stations has repeatedly brought to my notice the lack of care taken in the construction of various home-made wireless instruments. From their rough, and sometimes ugly, appearance, they plainly show that their construction was rapid, and upon being electrically tested, they usually fall far below the point of practical efficiency.

At three different radio stations I recently observed a part of the apparatus, namely, a rotary spark gap, appearing in a general way as those so frequently explained in the columns of this magazine. One of these gaps had the appearance of originally being the property of some high-grade electrical supply house. From the strong durability, accuracy and excellent finish, its efficiency could be read at a glance. The other two gaps had a rough, thrown-together appearance, due entirely to the method of construction and not to the material used. Each owner claimed his gap superior to those previously employed. With this self-formed knowledge they were satisfied.

Being interested in these young men, I took an opportunity to roughly test these three spark gaps, resulting in the gap first mentioned producing the highest reading, and noted as 100 per cent. Using this as a basis of calculation the remaining two were found to be 80 and 55 per cent. efficient, respectively. It took this demonstration to prove to one of the owners that his gap could be greatly improved upon. It is well known that a great many of our young radio men make this same mistake, and very frequently—but why? Because the average experimenter usually fails to put his knowledge into a reality, this being more apparent when he cannot obtain the help of an advanced scholar, and because he does not keep to the fundamental parts of the subject. Instead, he tries to understand the advanced theories of the mechanical and electrical details, far in excess of his training, invariably ending in his taking too many of these for granted.

In the making of radio apparatus the most destructive method lies in the quick, hit or miss, construction. Accuracy, both electrical and mechanical, cannot be too rigidly applied to this class of work.

The length of time required in the making of any instrument is a very important factor, but it is often sadly neglected. The greater part of this time should be used in working out the proper steps to be taken, combining any advantages that may be practically applied, especially those which follow the fundamental laws governing the subject under construction. At this point many meet with failure; they neglect to slowly analyze every detail of the work for the slightest defects. A few minor additions as can be practically worked out from the laws upon which wireless telegraphy is based and rightly applied to separate parts of the apparatus, will represent a large amount of the total efficiency produced from a combined set of high frequency apparatus.

The sketch submitted will serve as a partial demonstration of the foregoing negligence. This gap is capable of handling powers from ¼ to 2 kw. input at the transformer. Several details have been added—details pointed out by the fundamental laws of radio apparatus. As these are explained, their reasons of adding a greater efficiency should cause a feeling of regret to those not capable of thinking for themselves the numerous

ways in which they may be directly applied to other parts of the apparatus.

The electrodes being made of zinc or brass produce the clearest toned spark, especially the former when the metallic vapor can be sufficiently dissipated by natural or artificial air currents. Their shape should be made as will best adapt them for handling the high frequency currents, and sufficient in size to safely carry the current without causing undue heat. Those of zinc require greater surface than those of brass.

Fig. No. 2 may be prepared by casting in a mould of plaster of paris, divided into two parts, or by trimming the face-end from a length of 9/16 inch round stock. The longitudinal diameter of the trimmed face covers the question of sufficient sparking surface, as pointed out by the fundamental law of skin or surface effect in high frequency currents. The horizontal diameter of ¼ inch is necessary in order to effect a clean break to the spark which gives it that clear musical note. With a ⅝ inch die a thread is run back about 1 5/16 inch. It is almost next to impossible to cut a clean full thread on zinc, owing to its softness. For this reason and from the fact that no great strain must be withstood by the electrodes, ½ or even ¼ of a full thread may be chosen. To make the work compact and of neat appearance the standard ⅝ inch hexigonal brass nuts, used in securing the electrodes, are cut into thirds, giving each a depth of about 3/16 of an inch. These nuts permit of adjusting all electrodes. Under those on the back of the disc and rotating arm, copper strips of the proper shape are secured for the purpose of soldering to the connecting wires.

Careful note should be taken of the manner in which these connections are made to the twelve stationary electrodes in order to insure the same wavelength in the oscillating circuit at all positions of the rotating arm.

When the electrodes are in their permanent position they should be accurately spaced and on the same plane, with

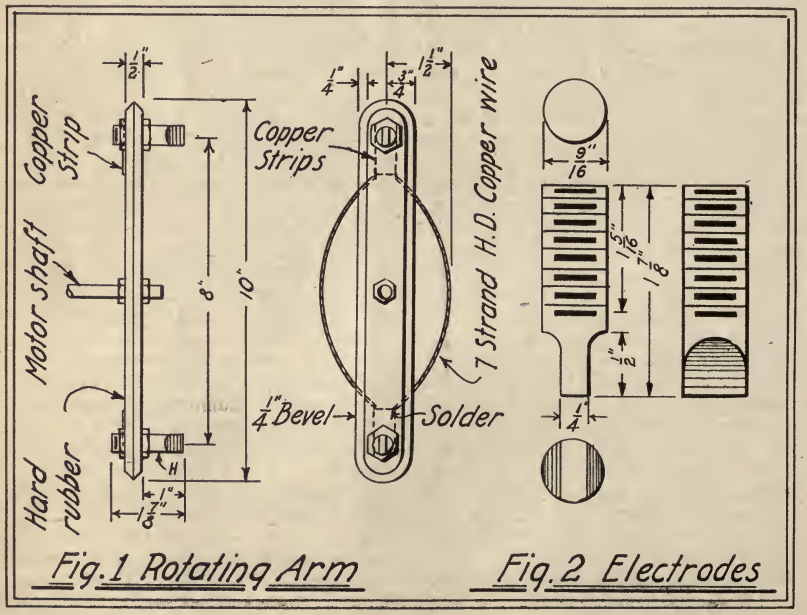


Fig. 1 Rotating Arm

Fig. 2 Electrodes

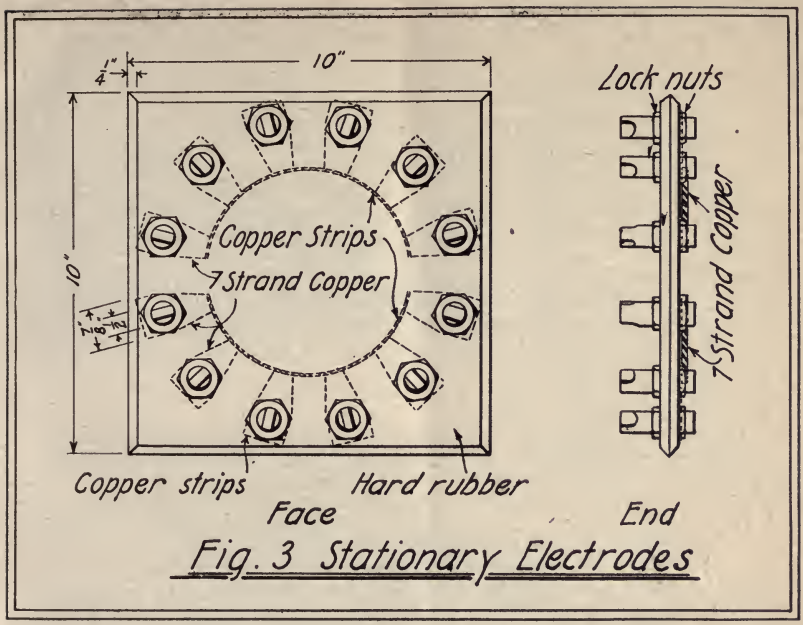


Fig. 3 Stationary Electrodes

the longitudinal diameter of their face-end at right angles to the center of the motor shaft.

For insulation and working qualities, hard rubber heads the list. Those who are unable to afford an extensive quantity should determine the next best material within their means, preparing it, if possible, to somewhat increase its dielectric strength, and not say, as many amateurs do, "Wood is an insulator, and will answer the purpose." True, wood is an insulator, but there are other and more practical compositions almost as inexpensive as wood. For instance, pressed fibre is a cheap insulating material which is easily worked into various shapes, but is defective on account of readily absorbing moisture. To a great extent this may be overcome by treating all surfaces with a thick and *smooth* coating of shellac or asphaltum.

Since high frequency currents flow mostly on the surface of a conductor, it is apparent that connecting wires of silver plated stranded copper wire or tubing are preferable to any other practical form. This form is extensively used in the Telefunken system. The next most efficient and that generally used, is stranded copper wire—*not the tinned variety.* Being round, the separate strands offer no opportunity for a brush discharge as does copper ribbon. The size necessary to safely handle powers between ¼ and 2 kw. ranges from 4,000 to 30,000 circular mils. To eliminate all possible brush discharge the edges of all metal parts and of the insulation must be rounded off.

No great importance need be attached to the speed of the rotating electrodes when the motive power of the gap is supplied from an 8-inch fan motor, since this can be controlled through resistance placed in the motor circuit. At no load, small motors are subject to "racing," and when the load is above normal the speed is decreased. Should an 8-inch fan motor be selected, the comparative weight and air resistance of a disc containing 12 electrodes being greater than

that of an 8-inch fan will cause the motor to be overloaded, decreasing its revolutions to a point below normal speed. To overcome this trouble the disc is made the stationary member. On the motor shaft is secured the rotating arm of hard rubber, sharpened to an edge on all sides, diminishing the air resistance to a minimum. The thickness of this arm must not be less than ½ inch, otherwise the speed of the motor will generate a centrifugal force upon the electrodes, causing the arm to be strained backward at both ends, increasing the distance between the stationary and rotary electrodes. This distance should be approximately maintained between ⅛ and ¼ of an inch. The arm may be balanced, in order that the motor will run perfectly smooth, by drilling small holes at *H*, Fig. 1, into the electrode at the heavy end.

For obvious reasons the gap should be well muffled. To gain space and eliminate vibration the muffled gap may be suspended from the ceiling at an accessible height.

To the experimenter who works out details of this nature, his efforts will always result in success.

RADIO MAST STRUCK BY LIGHTNING

ON the night of October 14th, last, one of those sudden, terrific, tropical thunderstorms such as are incidental to the countries lying in close proximity to the Equator, swept over the city of Colon. During the storm one of the tall masts of the Government radio station lying at the outskirts of the city was struck three times in rapid succession by bolts of lightning. The operator, foreseeing a possible danger from the approaching storm, had grounded his wires thereby protecting himself from injury or probable death.

When the storm had cleared away, it was found that the station was completely out of commission, the lightning having caused the aerials to break away from their supports. The mast, which was struck, was immediately inspected and condemned by the officials and its removal ordered.

A contractor assumed this responsibility and began plans for its demolishment. To provide against danger to the houses in the near vicinity, it was deemed advisable to fasten guy ropes at the extreme top with a view of keeping the mast from falling in the wrong direction and accordingly two men were detailed to undertake this task.

They had almost reached the top of the mast, when, without warning, it fell, striking the roof of an adjoining house, wrecking it badly and breaking the mast itself into five sections as shown in the views on the opposite page.

The two men were thrown over the house, striking the ground with great violence and being both instantly killed. The station is now being entirely rebuilt.—MELVILLE M. POTTER.

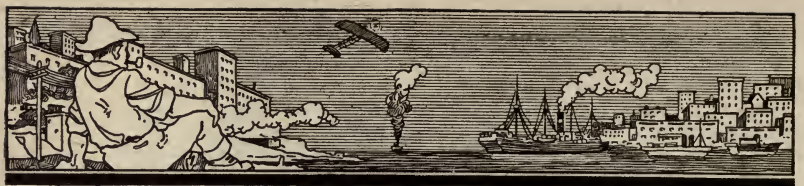
HUDSON VALLEY WIRELESS ASSOCIATION

At the election of officers of the Hudson Valley Wireless Association that took place on November 4, 1914, the following appointments were made:

President, Burr V. Deitz, Slingerlands, N. Y.; vice-president, John G. Wallace, Albany, N. Y.; corresponding and recording secretary, Howard S. Maguire, Albany, N. Y.; treasurer, Walter C. Rextrew, Albany, N. Y.

The secretary will be pleased to hear from anyone interested in the association. All communications should be addressed to him at 814 Lancaster street, Albany, N. Y.

In a recent test a wireless telephone system was used to carry on a conversation between Mare Island and Point Loma, 450 miles distant.



On Polyphase Subjects

AS the last forms of the February MODERN MECHANICS are going on the press, the entire city of New York is shaken with the news of what is undoubtedly the worst subway disaster in the history of the city's transportation system. From the maze of conflicting reports issued as this is being written, it is gleaned that at about eight o'clock in the morning of January 6th, during the peak of the early morning rush, a short circuit was established on the massive feeder cables inside the subway wall at Broadway and Fifty-third Street. The resultant arc immediately set fire to the insulation on the cables and within a few moments dense clouds of heavy smoke filled the tunnel. The short circuit, of course, caused the breakers to blow at the power station and almost immediately every train on the entire line from Brooklyn, beneath the East River, to Harlem on the North was stalled—many of them between stations. In the pitch darkness that ensued, panics started and hundreds of passengers suffered injuries from bruise and shock.

The situation at the point where the short circuit occurred was horrible. In the dense fumes of burning insulation, together with the terrifying darkness, the passengers, packed like sardines in the cars, struggled to escape into the tunnel, only to find after they had forced their way through windows and doors, that the atmosphere in the subway was worse, if anything, than that in the cars.

To this struggling mass of humanity beneath the ground, the firemen and police soon fought their way through manholes and emergency exits in the street, handing out the smoke-begrimed forms, unconscious and with the clothing almost torn from their backs. In the rescue work, many of the first to enter the tunnel succumbed to the fumes and were in turn rescued by those who followed.

It would seem that some practicable way should be devised either to provide a slow-burning or non-inflammable insulation for feeder cables on which short circuits are inevitable, or else to so segregate the cables or seal them from the subway tunnel that the smoke emitted could not find its way in any great volume into the tunnel. The fumes from an overheated motor or a blown fuse are almost stifling in such an atmosphere and the infinitely greater volume from a mass of burning rubber and varnished cambric can well be imagined.

These comments would scarcely be complete, however, if they did not include a tribute to one of the newest achievements of medical science, the pulmotor, to which hundreds upon hundreds of the unfortunates in the present accident owe their lives beyond question or doubt.

ABOUT a year ago a magnificent edifice was erected in the city of The Hague, Holland, and named the Peace Palace. Here it was intended that nations having disputes of any nature should present their cases before an assemblage of representatives from disinterested nations. The decision of these representatives was to be a final one and respected by the nations at odds. Thus it was planned that arbitration would settle disputes in a sensible and fair manner without resort to arms and consequent bloodshed and misery. But along last July came an incident that led to the great European struggle that is raging today. It would have been a simple matter for both countries originally concerned to present their cases before an international court of arbitration, but, instead, they resorted to the strength of their arms to determine the issue. Other countries bound by treaties or interests took sides with the result that a gigantic war followed. All this goes to prove that the world has not yet reached—and probably will never reach—a degree of enlightenment where wars will be permanently abandoned. Now we come to the question of great moment today: Is the United States prepared for war with other great powers? Elsewhere in this issue appears an article by an authority touching on this subject. While the nature of the article is not intimately associated with our editorial policy, it has been presented to the readers because of the great importance attached to it.

Pardonable Mistake

"Tickets," said the collector as he opened the door of the car in which sat a man who looked as if he was anchored to his seat. The man handed over the pasteboard, which was duly inspected. Then, looking around, the collector said: "Is there another gentleman in the car?"

"No."

"Is that other portmanteau yours, then, too?"

"Other portmanteau?"

"Yes; on the floor there by the other."

"Those," said the traveler with dignity, "are my feet."—*Houston Chronicle.*

Before and After

"Jack," said the young wife after she had just danced with her husband, "you've certainly improved wonderfully in your dancing. Don't you remember how frightfully you used to tear my dresses?"

"Yes," replied Jack, "I wasn't buying them then."—*New York American.*

Twain's Errand

Mark Twain did not cherish a fondness for the average office boy. He had an idea that the genus was insufferable, and invariably when the humorist sallied forth into some business office there was immediate armed hostility between him and the office boy.

One day Mark went to see a friend at his office, and the office boy on guard, in icy tones, said:

"Whom do you wish to see?"

Mark mentioned his friend's name.

"What do you want to see him about?" came next from the boy.

Mark Twain immediately froze up, and then with a genial smile, he said:

"Tell him, please, I want to ask his hand in holy matrimony." — *Chicago Ledger.*

One Precaution Overlooked

"Didn't you say," demanded the young man of the captain, "that this ship was equipped with all appliances for human safety?"

"I did."

"Then how does it happen that I now find myself engaged to a lady I did not know when the vessel left her pier?" *Judge.*

Sharing the Loss

Mr. Golden had a new office boy. A few days after his arrival some money was missing from the cash drawer.

Calling the new boy into the private office, Mr. Golden said severely:

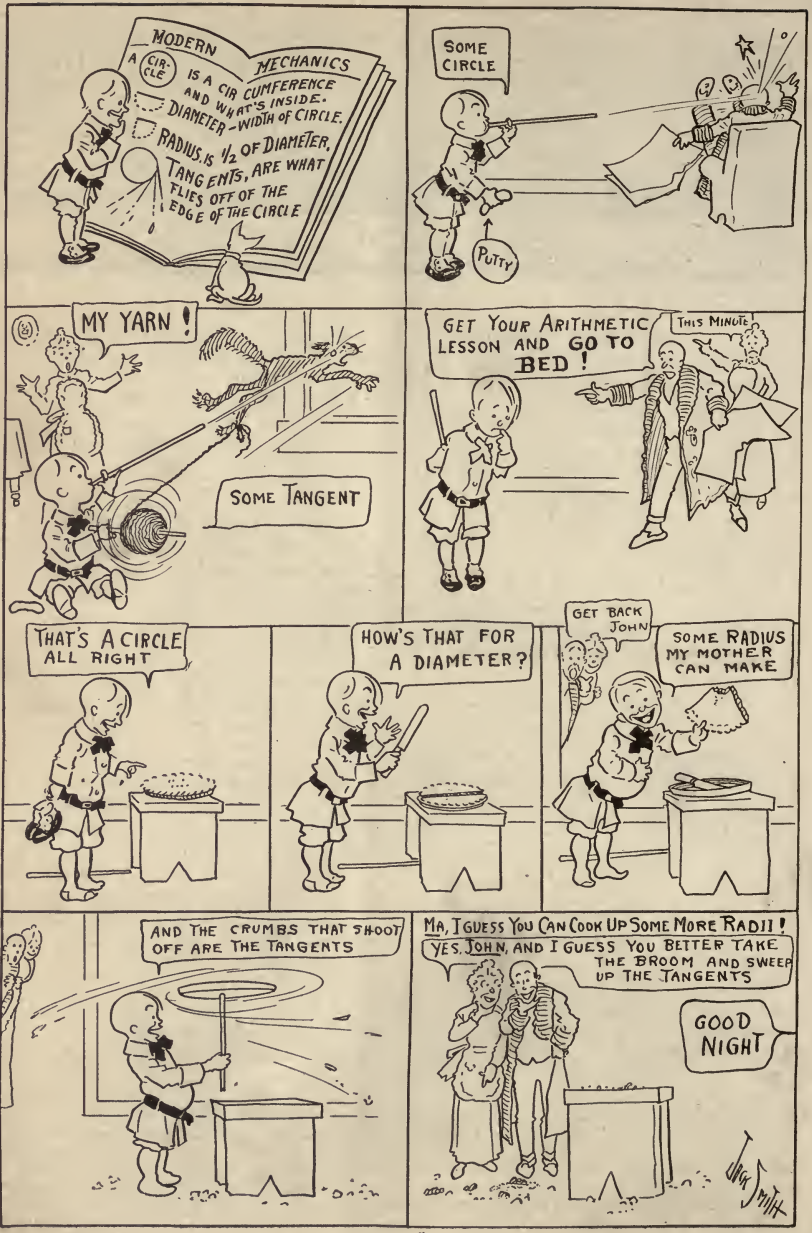
"There is $10 gone from my cash drawer, Albert. Now you and I are the only people who have keys to that drawer."

"Well," replied the boy cheerfully, "s'pose we each pay five dollars and say no more about it?"—*Harper's Monthly.*

Majority Rule

"I never like to drink from a public cup."

"Go ahead, stranger, it's all right. Everybody uses it."—*Life.*


MODERN MECHANICS
A CIRCLE IS A CIRCUMFERENCE AND WHAT'S INSIDE.
DIAMETER - WIDTH OF CIRCLE.
RADIUS IS 1/2 OF DIAMETER.
TANGENTS, ARE WHAT FLIES OFF OF THE EDGE OF THE CIRCLE
SOME CIRCLE
PUTTY
MY YARN!
SOME TANGENT
GET YOUR ARITHMETIC LESSON AND GO TO BED!
THIS MINUTE
THAT'S A CIRCLE ALL RIGHT
HOW'S THAT FOR A DIAMETER?
GET BACK JOHN
SOME RADIUS MY MOTHER CAN MAKE
AND THE CRUMBS THAT SHOOT OFF ARE THE TANGENTS
MA, I GUESS YOU CAN COOK UP SOME MORE RADII!
YES, JOHN, AND I GUESS YOU BETTER TAKE THE BROOM AND SWEEP UP THE TANGENTS
GOOD NIGHT
JACK SMITH

MODERN MECHANICS In Plain English

Vol. 30 MARCH, 1915 No. 3

ANNOUNCEMENT

WE find with considerable regret that not a little confusion has arisen among our friends and readers due to the similarity of the name of our magazine with that of a contemporary publication.

However, to the reader who has followed the development of the present MODERN MECHANICS *through the many years since "The Popular Electrician" was founded back in 1890, it is superfluous to say that at no time has it been our aim either to imitate or to bask in the well-deserved prestige of any other magazine. Thoughtful readers will appreciate that the policy of our magazine is quite different from that of any other publication, even though at first glance it may resemble some others in a general way just as dozens of other magazines and newspapers are identical in make-up and style.*

MODERN MECHANICS *makes no effort to report a new device or achievement solely for its news value; the aim is rather to include in every article some feature of practical value—something that may enable someone, perhaps in a far distant land, to profit by the experience of the individual referred to in the article.*

The articles in MODERN MECHANICS *are long enough to tell the story without being so long as to seem wearisome.*

They give the reader a general review of the world's advance in electricity, mechanics, science and invention and show him not only what is being accomplished but also how it is done.

Therefore, in view of the fact that the present title does not properly cover the contents of our publication, as well as to eliminate all possible criticism, it has become essential to make another change in name. The new title will enable us to continue in every particular with the same editorial policy as heretofore, while the new name will more clearly express the contents of the magazine. Hence, commencing with the April issue, the magazine will be known as "THE WORLD'S ADVANCE."

The reader is referred to page 431 of this issue for additional comments on this subject.

The Editors.

February 15, 1915.

A DESCRIPTION of an unique type of submarine diving apparatus with which a Western inventor contemplates bringing valuable submerged wrecks to the surface.

THE successful casting of an approximately eight-foot sphere, the largest shell ever cast, so it is claimed, is a step toward the realization of the dream of ages—the recovery of the untold millions of treasure that are known to be lying at the bottom of the sea.

Within the last few months still more treasure has been sunk, and, indeed, the ships and valuable contents sent to the bottom since the outbreak of the war represent sufficient salvage to warrant the development of the new type of diving apparatus which has some of the features of the submarine and some resemblance to the diving bell, although its inventor has developed other devices that are absolutely unique.

The diving apparatus, which is the idea of a Los Angeles inventor, consists of a hollow metal shell somewhat less than eight feet in interior diameter, and designed to contain two operators and a number of mechanical devices. The shell is to be used in connection with a tender ship to which it is connected by cables supplying electrical power and permitting of telephonic communication between the men below and the tender. The electric power serves to operate a motor which in turn drives two propellers mounted on universal joints, designed for allowing a wide range of exploration while connected with the vessel above. For instance, while the general location of many treasure-bearing wrecks is known, it may be necessary to explore quite a wide radius before the hulk is found, and this is accomplished by the propellers as well as several searchlights carried by the submarine chamber.

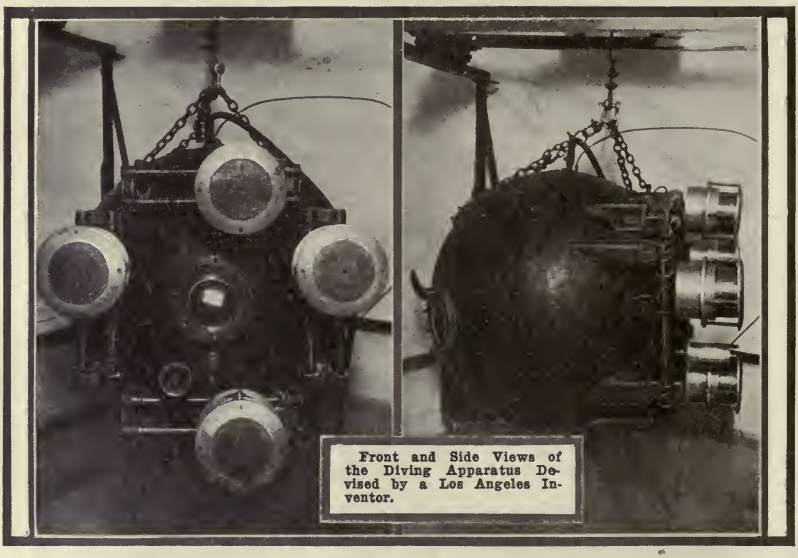
The inventor of the diving chamber has a novel method of bringing wrecks to the surface. It requires a number of pontoons, varying according to the size of the sunken ship. These are in the form of steel cylinders with corrugated walls. Each cylinder contains a small motor-driven pump. The pontoons after being filled with water are carried down to the hulk by the submarine. After being attached to the side of the wreck, the pumps empty them and their buoyancy raises the hulk to the surface.

The method of attaching the pontoons brings into operation one of the most remarkable features of the submarine device—a series of huge magnets on the submarine, which are energized by the electric current from the tender when the submarine is

Above: Pouring the Iron for Casting the Eight-Foot Round Shell to be Used for Submarine Exploration. Below: The Shell as it Appeared when the Metal had Cooled.

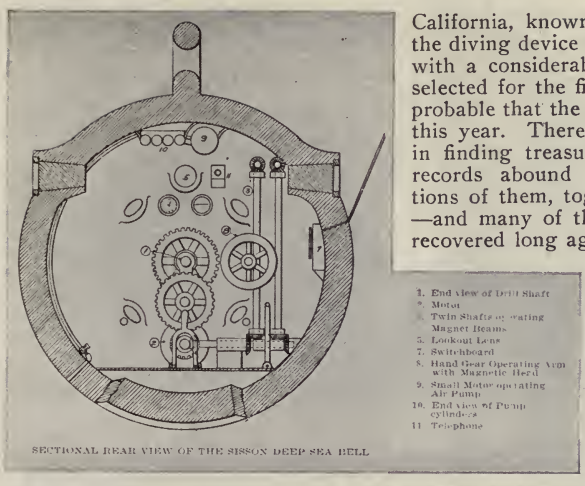
ready to operate on the hulk. The magnets hold the submarine firmly to the iron or steel plates of the wreck, while a motor-driven drill bores a hole into the side. This operation takes place after the pontoon has been set in a proper position beside the wreck. The pontoons are fitted with several steel cables on the ends of which are special hooks held upright by floats. After drilling a hole, the submarine, while still held by the magnets to the vessel's side, moves a few inches to one side; this being accomplished by a worm gear that shifts it to a given distance. Then the end of the first pontoon cable is seized by a magnetized arm and the automatically-locking hook is set in the freshly drilled hole. The submarine is then moved a short distance, another hole is drilled, and again a pontoon hook is inserted. This procedure is repeated until the wreck is firmly attached to the first pontoon.

After a pontoon has been attached to the hulk, the submarine ascends to the tender and brings down a second pontoon, repeating the operation until the hulk is surrounded by these metal cylinders. It is understood that each is connected by a power line to the tender above, so that when the time for pumping out the water arrives, each can be emptied independently, or all together, as desired. Since the submarine can keep in touch with the tender by telephone and at the same time observe the operation of the work below, it is possible to conduct the pumping in such a manner that the hulk will be floated on an even keel, by emptying some pontoons faster than others. Once at the surface, it is only a matter of towing the wreck to some convenient harbor for securing the contents, and if the vessel is not irrepairably damaged, for making it seaworthy.



Front and Side Views of the Diving Apparatus Devised by a Los Angeles Inventor.

In the case of vessels sunk in war, it may be possible in most cases to repair the ships for further service. The same possibilities are logical in cases of shipwreck occurring through striking a submerged rock. Many of the older wrecks would be of value for their contents alone, and some of them



Diagrammatic View of the Interior of the Diving Apparatus, Showing the Various Controlling Devices.

are known to carry millions of dollars worth of gold and silver coin or bullion.

A sunken vessel off the coast of California, known by the inventor of the diving device to have carried a safe with a considerable fortune, has been selected for the first venture, and it is probable that the attempt will be made this year. There will be no difficulty in finding treasure ships—official sea records abound with exact descriptions of them, together with locations—and many of them could have been recovered long ago but for the lack of efficient diving apparatus.

One of the principal mechanical difficulties, the casting of a spherical shell of the required size, has just been overcome. It is 1¼ inches thick, has a weight of six tons and is formed of a metal which is rendered malleable by a secret process, yet is sufficiently rigid to withstand the pressure of the sea to a depth of a thousand feet.

BETWEEN THE LINES LIES SAFETY

In an effort to help along the "safety first" campaign, prominent street crossings in Cincinnati have been marked off into lanes by two white lines about ten feet apart. It is in the lane thus designated that safety is found by the pedestrians, since danger of being struck by an automobile or other vehicle is eliminated. Drivers do not cross the white lines until signaled to do so by the traffic officer and people have been quick to learn that they should not attempt to cross the street outside of the white lines. At the curb "step-off" at each corner is painted the injunction "Walk Between These Lines." As the painted lines are liable to wear off, they will be replaced in the future by lines of white bricks laid in the paving which will make the lines absolutely permanent.

The White Lines Mark the Lanes through which the Pedestrians May Cross the Streets in Safety.

A Handy Watering Can for Reaching Flower Pots Placed on High Shelves.

A HANDY WATERING CAN

One of the most handy things ever devised for the watering of ferns and flowers which happen to be located upon shelves far above the reach of the ordinary person, is the little device just invented by a Californian. With this simple apparatus it is possible to eliminate all climbing and much of the regular work in the operation of plant irrigation in the modern business or home place. This little device consists of a can something like two inches in diameter and seven inches in length, to which a wire or "tipper" about an inch in length is soldered to the side about an inch from the top of the can. To this can is also soldered a wire handle, this being fastened to either side of the can, so located as to permit the can being tipped quite readily. The opposite end of this wire holder is fastened to a handle of sufficient length to reach any of the flowers that are to be watered.

FIGHTING THE MOSQUITO IN PANAMA

Almost as important as the work of the canal builders was that of the Sanitary Corps, whose campaigns against tropical disease made possible the accomplishment of the great task. The accompanying view shows two of the Canal Zone mosquito fighters. These men operate in pairs, one carrying the pressure tank and the other an extra supply of oil. They cover the entire Zone and it is safe to say that every pool of still water is frequently sprayed with the poisonous oil which has put such an effectual check on the breeding of disease-bearing insects.

These men are not natives of Panama. They are West Indian negroes; the zone natives having proved absolutely worthless as laborers, according to reports.

Two Mosquito Fighters in the Canal Zone, carrying their Weapons.

A NEW TYPE OF EXCAVATOR

An excavating machine in use in Los Angeles employs a novel system in making the dirt fly. It is driven by an electric motor, operated on a light and power circuit.

Various Views of a New Type of Excavating Machine employed by a Los Angeles Contractor. The Scraper Picks up the Earth and Dumps it into a Waiting Wagon.

In this new excavator the usual familiar device of a chain of buckets is discarded. Instead, one or more scrapers attached to wire cables are used, the cable being endless and so adjusted that the pull of the motor draws the full scraper to the scaffold, where it is automatically dumped into a waiting wagon, while the reverse action draws the empty scraper back to the starting point. Here a laborer is waiting for it, but his work is quite light, as he merely grasps it by the handles, steers it for a few feet until it is full of dirt, and then lets the cable draw it up the incline to the dumping place. In order to get the reverse action, it is necessary to stake out the cable around the excavation and provide pulleys for it to run on.

The operation of the new excavator is remarkably speedy, since it pulls the dirt up the slope and dumps it ten times as fast as a mule-drawn scraper could do the work. Two scrapers can be employed even more economically, for, while a laborer is required for each scraper, the motors of two can be operated by a single engineer. His duties are merely the throwing back and forth of a couple of levers.

PUMICE—NATURAL AND ARTIFICIAL

Pumice is a volcanic rock that, when ejected from the volcano, has been made porous by the sudden expansion of gas or steam imprisoned in it. Although the stone is useful in the industrial arts, especially in leather and felt work, in sculpture and stucco-work, and in polishing woods and grinding lithographic stones, the texture and hardness of it vary so much as to make it untrustworthy for exacting work. That has led to the introduction of an artificial stone,

said to be better than the natural pumice. This is, or until recently was, manufactured at Bietigheim, in Germany, from sandstone and clay, combined in different ways to produce at least ten grades of pumice.

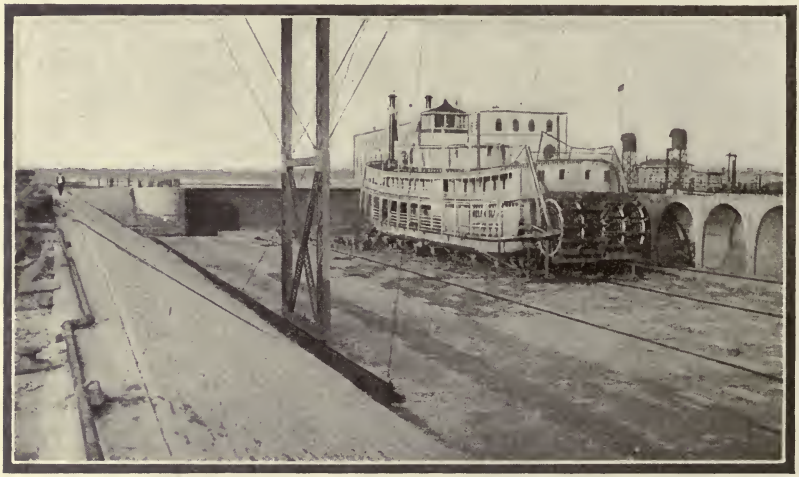
Most of the natural pumice used in the United States is imported. The value of the native supply, according to the latest available figures, was $33,439. It is obtained principally from deposits in Harlan and Lincoln counties, Nebraska.

THE WORLD'S GREATEST INLAND DRYDOCK

When the upper half of the Mississippi River was closed to navigation in November, the largest inland drydock in the world, located at Keokuk, near the big dam, was ready for use. It is of sufficient size to accommodate the largest boats and can easily care for several boats at a time of the size plying the Mississippi River.

The drydock is 463 feet long and 150 feet wide. A huge travelling crane is an important feature of the big plant, as it renders possible the making of the most extensive repairs on river boats. A half dozen buildings, including the administration building, a machine shop, store houses and shops, form an important part of the drydock.

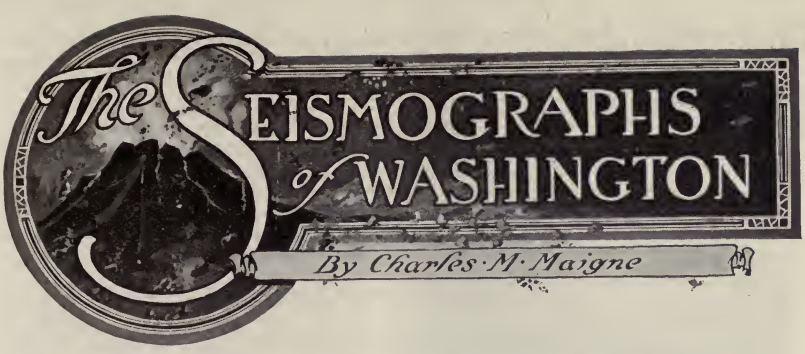
It is expected that the Keokuk drydock will prove a big boon to the navigators of the Mississippi River.



The Keokuk Drydock on the Mississippi River, Said to be the Largest Inland Drydock in the World.

BUILDING A ROAD BY DYNAMITE

Not long ago road-builders near Nevada City, California, used dynamite in building a half-mile stretch of road on the side of a hill. They placed the dynamite in vertical holes five feet deep along a line that was to mark the upper side of the road. When the dynamite exploded it blew the earth out toward the down-hill side. Little shoveling was needed. The road-builders used dynamite also to split fallen trees, and with the logs built an eight-foot corduroy road across a long stretch of swamp-land. In eight days, it seems, eight men completed the road at a cost for labor and material of $264, or 10 cents a lineal foot.



BEFORE the cable, telegraph or wireless means of communication can send the news of a volcanic eruption around the world, delicate mechanisms known as seismographs have already imparted the fact and recorded the violence of the disturbance in distant cities.

ON the stately heights of old Georgetown, overlooking the winding stretches of the Potomac, there stand the buildings and towers of Georgetown University, and in the heart of the great quadrangle, fifteen feet below the level of the ground, is a concrete and non-conducting cave jealously guarded from the tread of disturbing mankind.

In the heart of the cave, just as a nest of weird, ungainly spiders of human devising, with threads of web extending far and wide across the land, are grouped delicate contrivances of steel and brass, bronze, vulcanized rubber and platinum, as, with microscopic accuracy, seismographs which record near and distant tremors of the earth keep their ceaseless watch.

Their platinum pens, as they scratch across the sooted surface of the smoke sheet placed on the revolving drums, may tell of disturbances within the earth, valuable only to science in the study of seismology; or they may record a cataclysm in a distant land; and their faint whisperings, when amplified by the lightning flash of cable and wireless, may spell out a tale of terror, of rocking cities and falling masonry, of the horror of a sudden darkness wherein frenzied people flee blindly through debris-piled streets, amid the moans of the injured.

Twice each day, with reverend footfall, the great door of the cave is entered and the record of the preceding hours lifted from the instruments. Then it is filed with those that have gone before, and the story of its waverings is sent out to be compared with the "grams," as the completed records are called, of other stations scattered throughout the land.

Let us look at the theory of the instrument.

The seismograph is virtually an inverted pendulum, one end of which is practically rigid except for a complex hinge, called Cardanic, and with a mass of metal on the outstretched arm, as heavy as is consistent with the strength of the hinge. Delicately attached to the other end of the recording arm is the platinum pen, which, on the moving end of the strut, amplifies the faint movements transmitted from the rigid frame of the machine.

When the pier or support upon which the instrument rests is set in motion by the tremblings of the earthquake, the Cardanic hinge and the frame of the machine execute all the oscillations communicated to them, while the heavy mass of metal on the arm tends to keep its position.

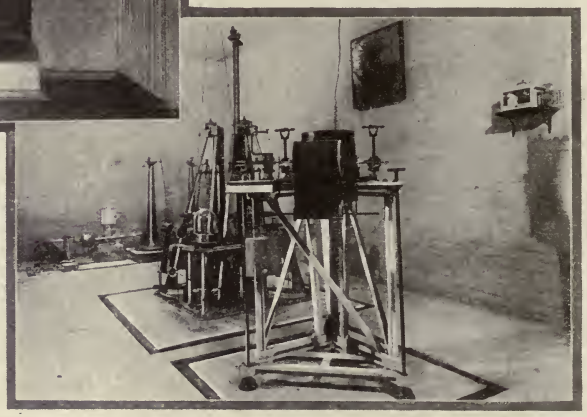
It is the inertia of the mass which

gives it stability. Between the mass and the frame, which is more or less agitated by the faintest earth tremor, there is a relative motion and the pens trace a record of the disturbance.

That it may not remain stationary when the frame oscillates, as the tremendous relative weight must be supported, the mass is attached to the frame against a spring. The pressure of the spring opposes the pull of gravity, acting on the mass, which is slightly displaced from the vertical position.

Just as a pendulum the mass executes harmonic motion and will have its own definite period or beat. This may be changed at will by adjusting the leverage through which the spring acts on the mass. It is through these levers that the desired magnification on the "gram" is secured. The long arm operates one of the recording pens and hence any movement transmitted to the latter will be multiplied on the record in the ratio of the long to the short arm of the lever system.

Unless checked, strong impulses would keep the mass in motion for a considerable time, thereby obliterating or accentuating earth-tremors and falsifying the record. To prevent this, what is known as a "damping" contrivance is used. Damping tends to hold the mass in check, preventing it, to a great extent, from executing



Above: Clocks Governing the Seismographs at Georgetown University. At the Right: The Seismographs that Stand on Concrete Piers that Reach Downward to Bed Rock.

Photos. by G. V. Buck, Washington, D. C.

by two thrust rods, which meet in the center of oscillation of the mass. These rods meet at an angle of 90 degrees and thence extend to the short end of a lever, the fulcrum of which is fixed rigidly to the frame, while its long arm works its own vibrations. The damping is accomplished by means of a piston connected by a rod to the lever system, and which moves to and fro in a cylindrical air chamber.

The resistance of the air opposes and

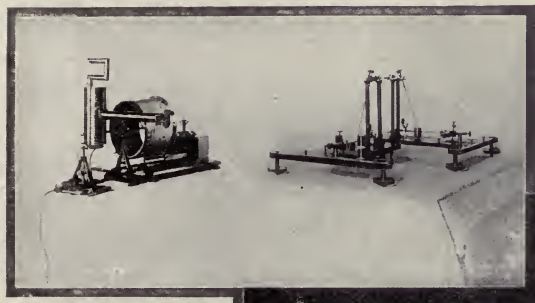
minimizes the pendulum's independent action. Through this system, the mass keeps itself from being thrown into violent swinging by earth disturbances, without losing its sensitiveness to minute tremors.

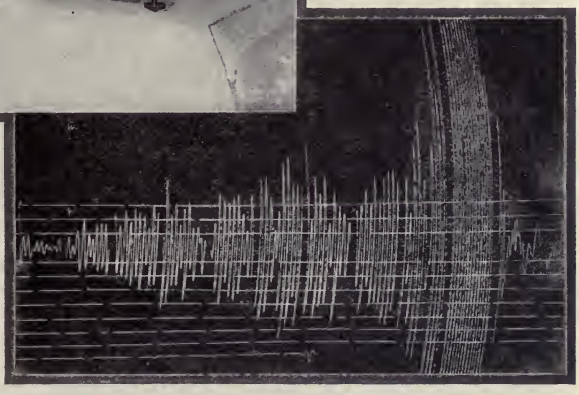
The Georgetown seismic station is under the direction of Fr. Tondorff, S.J., a young priest. He has been in charge of the station for about four years and in that time his labors have brought him into contact with leaders in science from all over the world.

Father Tondorff was asked recently if there were possibilities of science reaching the mark where an earthquake could be predicted in a certain locality. He replied that while almost anything was possible, but little advance had been made along this line.

"Each earthquake," he said, "is studied and its possible relation to other disturbances is analyzed. Much time is being given now to the periodicity, that is, the more or less regular intervals between disturbances of various intensity. Possibly some solution may be deduced from this, but it is difficult to say.

"Periodicity in earthquakes I may compare in a homely way with a somewhat similar occurrence, although very faintly. Have you ever noticed sliding snow on a roof? Some near the top will start to slide, through melting or some disturbance, and some projection will halt its progress. In a short time this will slide further, until it is checked again by some obstruction; finally, the increased weight of the snow will start it off again, and the whole mass of it will dash to the ground. We may compare the cumulative of this to the periodicity of a great earthquake," he concluded.





Above: Photographic Seismograph after Bosch, a Type that is Much More Compact than that Illustrated on the Opposite Page. At the Right: A Gram of a Violent Eruption.

The seismograph instruments are very delicate and very finely adjusted. There are four of them at the Georgetown station, one of which is a photographic seismograph, after Bosch. It photographs the seismic waves as they occur and is of great accuracy.

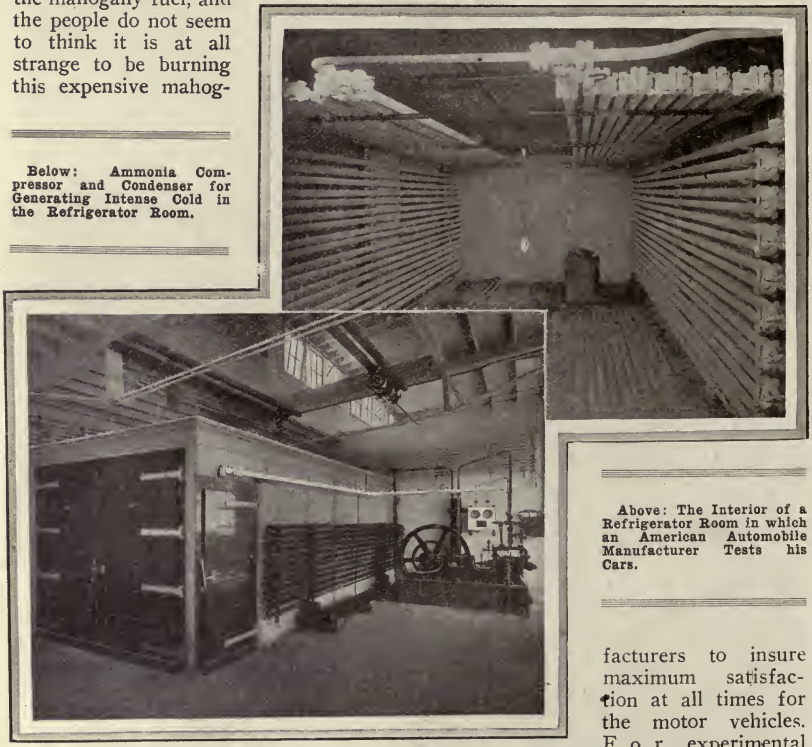
Another machine has been loaned from the station and is now in the frozen north with the Crocker land expedition, yet the remaining instruments are sufficient to check each other and their service to science is unceasing.

Don't fail to read the important announcement appearing on page 289 of this issue, concerning the April number.

BURNING MAHOGANY FOR FIREWOOD!

The residents of the little settlement at Jordan Valley, Oregon, have to take their choice between burning coal at $27 per ton, or mahogany wood at $18 a cord, and many of them take the mahogany. This wood is so hard that it ruins saws, and this adds to its cost as a fuel. There is a grove sixteen miles from the village, which supplies the mahogany fuel, and the people do not seem to think it is at all strange to be burning this expensive mahogany wood, so coveted for pianos and furniture. The reason for the high cost of coal in this mountain village is the fact that all freight which enters the town must be hauled up from the base of the mountain, and the charge for cartage on all commodities and merchandise of any sort is one cent a pound. The coal costs only $7 per ton at the base of the mountain, but the freight on 2,000 pounds at a penny a pound brings the cost up to $27 for every ton that reaches the summit.

Below: Ammonia Compressor and Condenser for Generating Intense Cold in the Refrigerator Room.



Above: The Interior of a Refrigerator Room in which an American Automobile Manufacturer Tests his Cars.

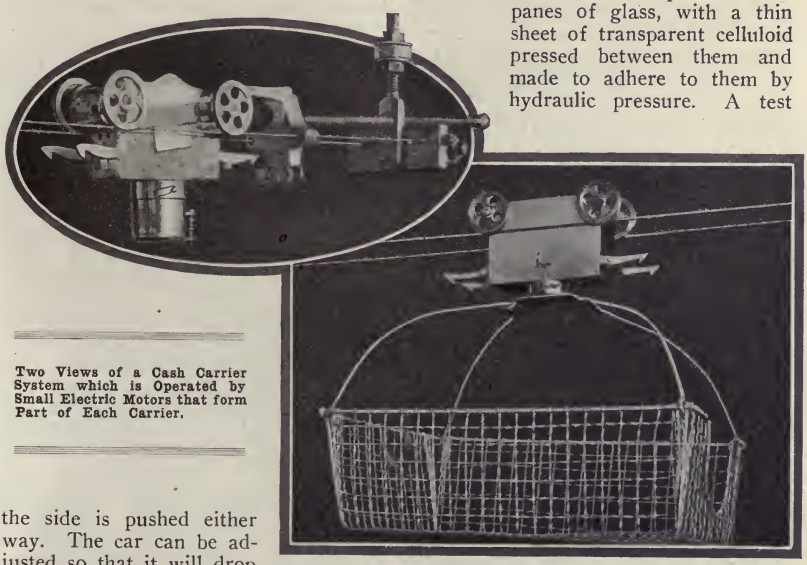
AN UNUSUAL AUTOMOBILE TEST

Automobiles are constructed to be of service in all kinds of weather and great trouble is sometimes taken by manufacturers to insure maximum satisfaction at all times for the motor vehicles. For experimental purposes an Indianapolis manufacturer makes use of a cleverly devised refrigerator room wherein tests for wintry conditions can be made regardless of the natural temperature prevailing. This room is large enough for the largest car and observations can be taken of all working parts in the below-zero "weather" of the refrigerator room.

ELECTRIC MOTORS REPLACE SPRING POWER IN CASH CARRIER SYSTEM

A striking innovation in cash carrier systems is presented in the invention of a Western window trimmer who has been working several years on an electric carrier to replace those operating by spring or pneumatic power.

The new cash carrier consists of a small car fitted with a miniature electric motor. To start the carrier a lever at the side is pushed either way. The car can be adjusted so that it will drop packages or messages at any point on the system and return to the starting point and stop. It will climb stiff grades and operate on a system that is circular or straight. The current for the motor of the cash carrier is supplied by a transformer, and suitable controlling devices permit of variation in the speed of the cars.



Two Views of a Cash Carrier System which is Operated by Small Electric Motors that form Part of Each Carrier.

Electric cash carriers have now been employed in a Western department store for over a year and have proven entirely satisfactory according to reports.

Don't fail to read the important announcement appearing on page 287.

THREE-PLY GLASS

It has been said that a great fortune awaits the individual who shall invent a flexible, unbreakable glass. "Armored glass," so called because it contains a netting of galvanized wire and is not easily broken into small pieces, is too heavy and too nearly opaque for most uses. There is a glass of comparatively recent invention called "three-ply." Although it is neither flexible nor unbreakable it has certain advantages over other kinds. It is composed of two panes of glass, with a thin sheet of transparent celluloid pressed between them and made to adhere to them by hydraulic pressure. A test has shown that a blow hard enough to shatter ordinary glass and to drive the pieces for some distance merely cracks the three-ply glass.

THE STOUTEST TIMBER

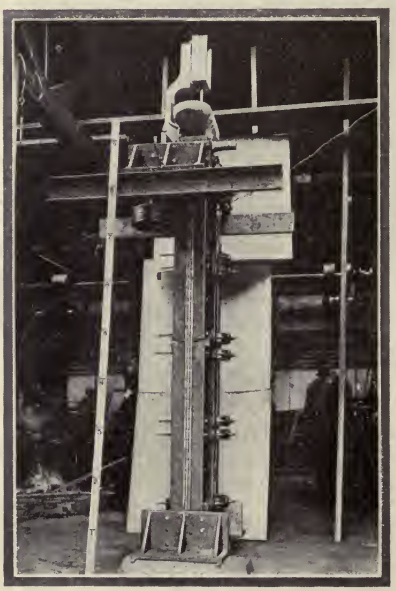
One of the most remarkable of the many hard woods of Australia is yate. According to some, this tree apparently furnishes the strongest timber known. Its average tensile strength is twenty-four thousand pounds to the square inch, equal to that of cast iron. Many specimens are even stronger, and one was tested up to seventeen and one-half tons

to the square inch—a tensile strength equal to that of wrought iron. The tree sometimes attains a height of one hundred feet and is often more than two and one-half feet in diameter.

MAKING ENDLESS BRASS RODS BY MACHINERY

The making of brass rods has for years required a number of tedious tasks. Today, with the invention of a simple-looking machine, brass rods are turned out automatically just as long as it is fed molten brass.

A man in Newark, N. J., has had this problem under consideration and the result is the perfection of the endless rod machine that turns out brass rod at the rate of from thirty to forty feet per minute. Once the machine is started all labor is dispensed with, excepting, of course, the melters whose duty it is to supply the machine with the necessary amount of molten brass.



By Means of this Machine, Continuous Brass Tubing can be Made with No Other Attention than to Furnish the Metal.

The continuous casting machine stands somewhat over nine feet in height and at its lower extremity rests upon two concrete piers. This space is for the delivery of the brass rod from the machine.

The conventional process of manufacturing rods has been to cast molten brass into stationary molds. With the latest invention the metal is fed into the top of the machine, flows by gravity through a guiding tube into the molding bore of the machine in the center, and the completed rod comes out at the bottom. The machine is said to work equally well on common brass and leaded brass mixtures. The effect of the machine is the same as the old fashioned two-part mold. The molds are divided into sections and are carried on two co-operating chains. As the chains are set in motion the two-part mold is continuously formed.

ARE HIGH BUILDINGS EVER PLUMB?

During the construction of Boston's highest building, the new Custom House tower, the elevator builders carried up their permanent guides as fast as the steel work was in place—something which was never before attempted in any building—due, of course, to the usual inability to plumb the giant framework of a high structure sufficiently to fasten permanent elevator guides in place.

In this building, over 625 feet high, the experiment was tried and has proved a decided success, not only to the elevator builders but to the designers and erectors of so many thousand tons of giant steel columns and beams.

At the twenty-ninth story the elevator guides and the great steel frame to which they were fastened were less than three-sixteenths of an inch out of true plumb! This is truly remarkable in spite of the fact that the great tower rests on no other foundation than that made by pneumatic caissons sunk to a depth of over a hundred feet into loose mud. It is doubtful if all tall structures are as straight as was the case with the new Custom House of Boston.

A REMARKABLE ARCH

IN the ruins of St. Dominic's Church in Panama there is an arch that is very remarkable. Although it seems impossible that this arch should remain standing after so many years, when nearly all the rest of the building is in ruins, it nevertheless still remains firm. The arch is made entirely of brick and stretches in a long span for the entire width of the church. No sane architect of today would attempt such construction. According to legend, the monks who erected the church had to build the arch three separate times: each time the supports were removed the arch would fall.

French soldiers examining the wreckage of a German monoplane that was hit by shrapnel and brought to earth. Riflemen and artillerymen have now attained a state of marksmanship where aeroplane pilots are in constant danger of being hit by rifle bullets or shrapnel.

A French family among the ruins of their home. In Galicia, western Poland, East Prussia, northeastern France, Belgium and some parts of Servia such scenes as this are quite common.

Distributing gifts to the German soldiers in Poland. As will be seen, one of the gifts is a sausage. Cigars are much in evidence as Christmas gifts among the German soldiers.

A French soldier arousing his sleeping comrade in order to share with him his Christmas box. During the Christmas holidays relatives sent many presents to the men at the front, such as wearing apparel, particularly warm socks and mufflers, tobacco, sweetmeats, etc. The Christmas holidays were duly observed on the firing line, in some instances the soldiers of both sides arranged a truce and even visited each other's trenches to exchange presents.

Photos. Copyrighted International News Service.

When the war was brought home to England: A view of a building that was partly wrecked as a result of German shells during the bombardment of West Hartlepool by a fleet of German warships. The inhabitants of this and other towns that were victims of the raid, on seeing the German warships approach shore took them to be British ships, since the belief existed that the German ships were securely bottled up. This accounts for the great loss of life.

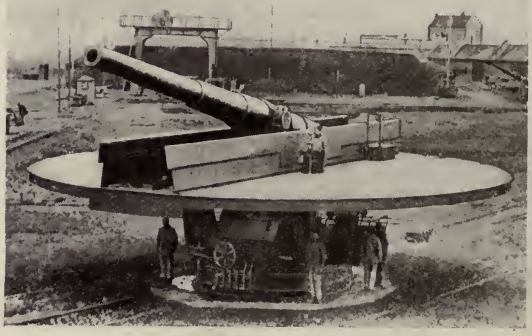
A section of trenches that have recently been dug along the bluffs of the east coast of England as a precaution against any attempt at an invasion by a hostile army. The recent raid has caused the British authorities to make many defensive preparations.

A wrecked shop in the city of Scarborough, England. It was struck by a shell from a German warship, killing the wife of the storekeeper. Many civilians were killed and wounded because of the fact that the raid was unexpected, the women and children having had no time to flee to safety.

Photos. Copyrighted International News Service.

A French machine gun being placed in position. This class of weapon has proven most deadly, and it is liberally used by the German and the Allied armies. At the beginning of the great war the Germans had a marked advantage in the vast number of machine guns they possessed, but present reports state that the Allies are now equal to their opponents in this branch of equipment.

An automobile scrap heap: Most of the automobiles that have been abandoned by the Germans are in such a damaged condition as to be of no serviceable value to the French soldiers. They are accordingly brought to the scrap heap shown here.



A type of disappearing gun that is being used in some of the French forts. It will be noted that the gun can be lowered and the steel doors closed down, thus protecting the mechanism and gun crew from hostile shell fire. A gun of this type is obviously intended to be surrounded by a mass of concrete, in a very similar manner to the steel cupolas of the Liege forts. It has advantages over the steel cupolas and might perhaps withstand the bombardment of huge howitzers.

Photos. Copyrighted International News Service.

Above: A reproduction from a composite photograph showing a French biplane attacking a German Taube monoplane. While this incident was actually witnessed by a war photographer, the great speed at which the machines were travelling prevented the photographing of both together. Each machine was photographed separately.

Below: A French long-range gun in action in the Flanders section of Belgium. This type has only recently made its appearance and is intended to reply to the powerful German howitzers.

Photos. Copyrighted International News Service.

A few of the 200,000 Japs who greeted the German prisoners of war from Tsingtau upon their arrival in Tokio. With the capture of the German stronghold in China, Japan's military activities in the great war have practically ended, although the German prisoners must be held in custody until peace is arranged between the countries at war.

The lighthouse at Scarborough which was pierced by a shell from one of the German raiding ships. This structure was one of the most prominent targets selected by the German gunners. The bombardment was, according to reports, systematic, the German crews having probably laid plans beforehand as to the important points of the city that were to be bombarded.

Japanese troops landing railway iron for laying a light railway from Saoshan to the Japanese front near Tsingtau. The siege of Kiauchau was conducted with the same precision as that of Port Arthur during the Russo-Japanese war of ten years ago.

Photos. Copyrighted International News Service.

A company of French infantry marching through a sacked village in northern France on their way to the front. At many points along the battle front in France, villages have changed hands many times; in some instances a village may be occupied by the Germans in the morning, by the French in the afternoon, and again by the Germans the following morning.

French soldiers examining their Christmas boxes. This view is of particular interest because it shows the hardships that must be endured by the men in the trenches. Water often accumulates in trenches that are not provided with means of drainage, resulting in ill health to their occupants.

A Belgian airman handing a dispatch to a motorcycle messenger. The aeroplane has proven a valuable instrument for reconnoitering the position of the enemy, while the motorcycle has had its greatest field of usefulness in the carrying of dispatches.

Photos. Copyrighted International News Service.

After a battle: French Red Cross aides searching for the wounded. The skill and efficiency of the medical corps connected with all the armies at war have done much to reduce the toll of life.

A section of the English coast trenches. These earthworks are constructed along the same lines as those on the Continent, and are provided with bomb-proof shelters and barbed wire entanglements. They are intended to withstand a bombardment by warships and repulse an attempted landing.

Austrian Infantry securely intrenched against their Russian foe. The Austrians have suffered many reverses in the present war, but in all fairness they must be admired for unflinching courage. Even after the most severe defeat, the Austrians soon reorganize their battered armies and again return to face the enemy.

Photos. Copyrighted International News Service.

Belgian aviators and one of their machines. For the most part the Belgians have been using biplanes of the Farman type, while the Germans show a preference for the monoplane type. The English and French use both types in about equal proportions.

The well-known English aviator, Claude Graham White, at the front. He is not only a famous aviator but also a designer and constructor of machines that bear his name.

A British aeroplane that was dashed to earth at Ypres. On the underside of the planes of British airships are painted Union Jacks so as to distinguish them from German aeroplanes that are marked with black crosses.

Photos. Copyrighted International News Service.

At the Left: An explosion of the new powerful explosive invented by Lt. H. C. Woodward of the Twenty-second Regiment Engineers, N. G. N. Y.

At the right: Preparing a charge of the new explosive, Trotol-Gelatine, for the tests on land and submarine mines at Fort Wadsworth, S. I.

Above: Electric batteries which furnished the electric current for exploding the mines. At the right: The explosion of a submarine mine charged with 175 pounds of Trotol-Gelatine threw a column of water 375 feet high. The shock would have destroyed the most powerful battleship afloat.

Photos. Copyrighted International News Service.

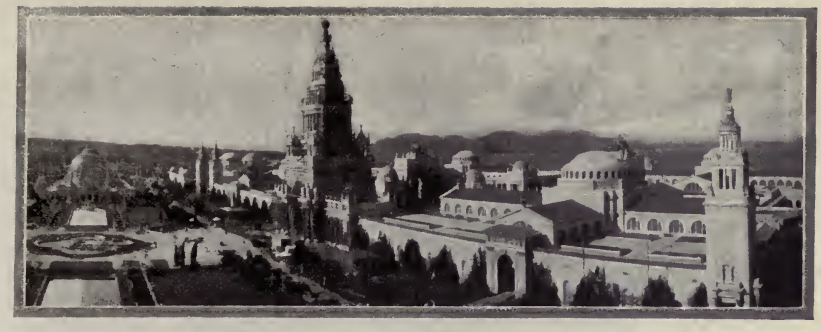
Above: A class of German recruits receiving instructions from an army officer on the use of a rifle. At the Left: An officer in a western prison wears the coat shown for protection against firearms. It is woven of steel and somewhat resembles an ancient coat of mail. It will protect its wearer from revolver bullets fired ten feet distant.

A dwelling built by the negroes of Porto Rico in two hours' time. The shelter is made of palm leaves supported by the trunks of dead coco palms. No nails are used.

A scene during the rugby game between Leland Stanford University and the University of California. This game is the big event in Pacific Coast athletics. A crowd of 26,000 witnessed the game. This view is a very unusual one, since it has caught the "pig skin" in mid-air.

Peculiar "cabbage rocks" found along the shores of the Columbia river. The rocks on the shore are soft and are continually crumbling away, sometimes into curious shapes.

At the Right: A gusher in the oil fields near Bakersfield, Calif., recently caught fire and burned for several days before it could be extinguished. Eighty acres of ground was burned over and the huge torch was only extinguished after several days' effort, using metal plates and live steam.



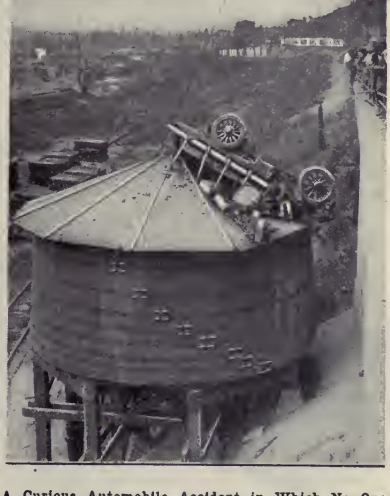
Panorama view from the dome of the Festival Hall at the Panama-Pacific International Exposition. The view shows the western part of the main group of exhibit palaces. The tall Tower of Jewels, in the center, which is 435 feet high, conceals the famous Golden Gate entrance to the Bay of San Francisco. The domed structure at the left is the Palace of Horticulture. The other palaces shown, from left to right, are those of Education, Liberal Arts, Agriculture, Manufactures and Transportation. Beyond these is shown the Bay of San Francisco, with Mount Tampais and the hills of Marin County.

FACTS CONCERNING THE NEW ELEMENT CANADIUM

It was about two years ago that there was discovered what is thought to be a new noble metal which may in time have important scientific and commercial results. This metal was found by A. G. French in the Nelson mining district of British Columbia and was named canadium. It is allied to the platinum group and occurs pure in the form of grains and short crystalline rods, and also as an alloy. Assays give three ounces or less to the ton. Canadium has a brilliant white luster, and like the three noble metals, gold, silver and platinum, does not oxidize when exposed to the air. The new element is softer than platinum, and its melting-point is not only several hundred degrees lower than that of any of the platinum groups of metals, but slightly less, even, than the melting-points of gold and silver. The physical and chemical properties of the new metal will be studied by many chemical laboratories. According to one authority, canadium is the first new metal to be discovered in anything more than infinitesimal quantities since Professor Winkler isolated germanium in 1885.

A VERY ODD AUTOMOBILE ACCIDENT

The motor truck of a Los Angeles fruit rancher recently turned turtle on a high bridge when the driver lost control



A Curious Automobile Accident in Which No One was Hurt.

of the machine. Instead of making a sheer drop of fifty feet, when the machine backed off the viaduct, it turned somersault, landing upside down on the top of a water-tank. The two Japanese riding on the truck were thrown into the tank through the roof but were unhurt. The Orientals were able to swim until rescued by way of a trap door in the side of the tank. The machine was badly wrecked.

A Pipe With a Row of Holes being Employed to Good Advantage as a Lawn Sprinkler.

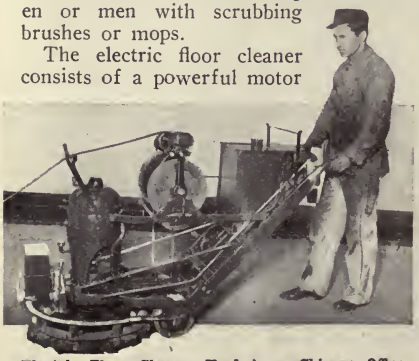
LAWN SPRINKLER OF UNUSUAL DESIGN

An unusual form of lawn sprinkler is shown in the accompanying illustration. It consists simply of a pipe capped at one end and supplied with water at the opposite end. The pipe has a row of holes through which issue streams of water. At the supply end the pipe is fitted with a valve for controlling the water, as well as a handle for turning the pipe so as to change the direction of the sprays. In one instance the sprinkler is employed in a park, the pipe being placed at the edge of a road. In the morning, before traffic commences, the pipe is turned so that the water is sprayed on the road. Later, and for the remainder of the day, the pipe is turned to direct the streams of water on the lawns. This form of sprinkler is so simple that it can be readily and cheaply made by anyone, without much trouble and with simple tools.

AN ELECTRIC FLOOR CLEANER

A rather unusual sight in a Chicago office building is one of the porters pushing an electric floor cleaner over the mosaic tile floor late in the evening, instead of the usual corps of women or men with scrubbing brushes or mops.

The electric floor cleaner consists of a powerful motor driving a number of brushes mounted on a suitable framework. Water and soap are supplied to the brushes as required. The reel on the truck plays out as much wire as may be necessary for connecting the motor to the nearest source of power. The equipment enables one man to clean the floors of the entire building with a considerable saving in time and expense.



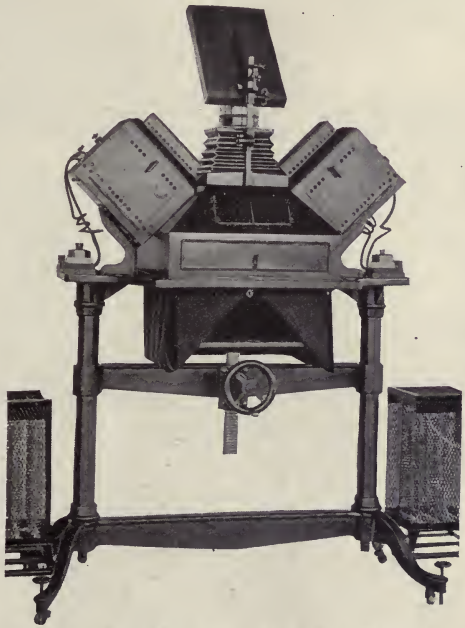
Electric Floor Cleaner Used in a Chicago Office Building.

The European war has given American electrical manufacturers an opportunity of extending their sales in foreign countries. In electrical machinery, Germany has exported more than $12,500,000 annually, $12,300,000 in incandescent lamps, and $10,400,000 in other electrical material. This amount of business, as well as that of other fighting nations, could be secured by American firms just now if properly solicited.

PROJECTION OF LARGE OPAQUE OBJECTS

While opaque projection is not new, the successful application in the case of large objects has recently been made possible by the introduction of the apparatus illustrated.

It is of interest to note that the original model was built as an experiment in response to the request for an instrument of sufficient scope to project on the screen an entire section of a cash register. So satisfactorily did the first machine operate in this connection that similar machines are now being used in educating salesmen to a more intimate knowledge of the product. An entire section of the cash register may be placed in the device and shown on the screen with the mechanism in actual operation. Large advertisements and placards may also be projected for the purposes of discussion and comparison by the salesmen present.



Large objects may be Shown with this Arc Light Projector, which was Originally Intended to Project on the Screen a View of the Entire Mechanism of a Cash Register.

It is pointed out that, in addition to these commercial uses, the new electric projector may be used to advantage in projecting full-page advertisements from large magazines, as well as photographs and engravings of any size up to twenty inches square. In educational work, too, lies some of its greatest possibilities for service, as it is especially suitable for projecting natural history subjects. All objects are clearly shown in their natural form and coloring in greatly enlarged images.

NOVEL LEAK-INDICATOR

An automatic leak indicator for ships consists of a number of small cast-iron boxes screwed to the bulkhead of each compartment and set at predetermined distances, one above another. In each box there is an electrical contrivance connected with an indicator-board either on the bridge or in some other convenient place. The board is fitted with a number of small glow lamps of different colors, and is connected with an alarm-bell. When the water rises to the level of the lowest box, it makes an electrical contact by which the lamp corresponding to the height of the bulkhead that the box indicates is lighted and so remains until the next box is reached by the water, when the second lamp is lighted. Meanwhile, the bell rings continuously until switched off.

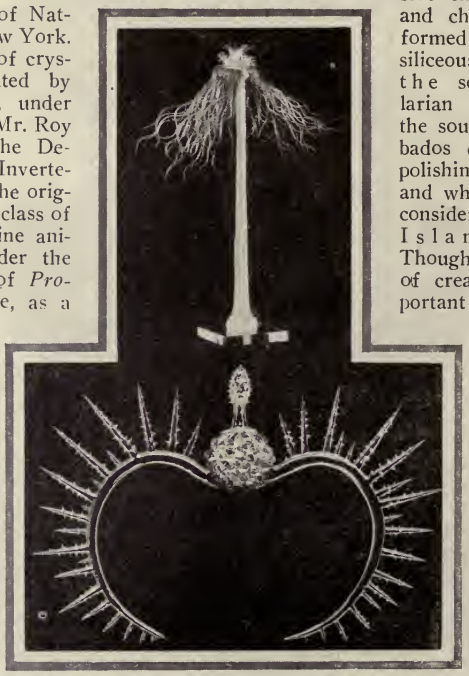
In many cities and villages the central electric station has, by way of equipment, a small transformer mounted on a wagon or sleigh and intended for the thawing out of frozen pipes. When a pipe is to be thawed, the transformer is brought up in front of the house and connected to the power wires.

Wonders of the Deep Sea in Glass

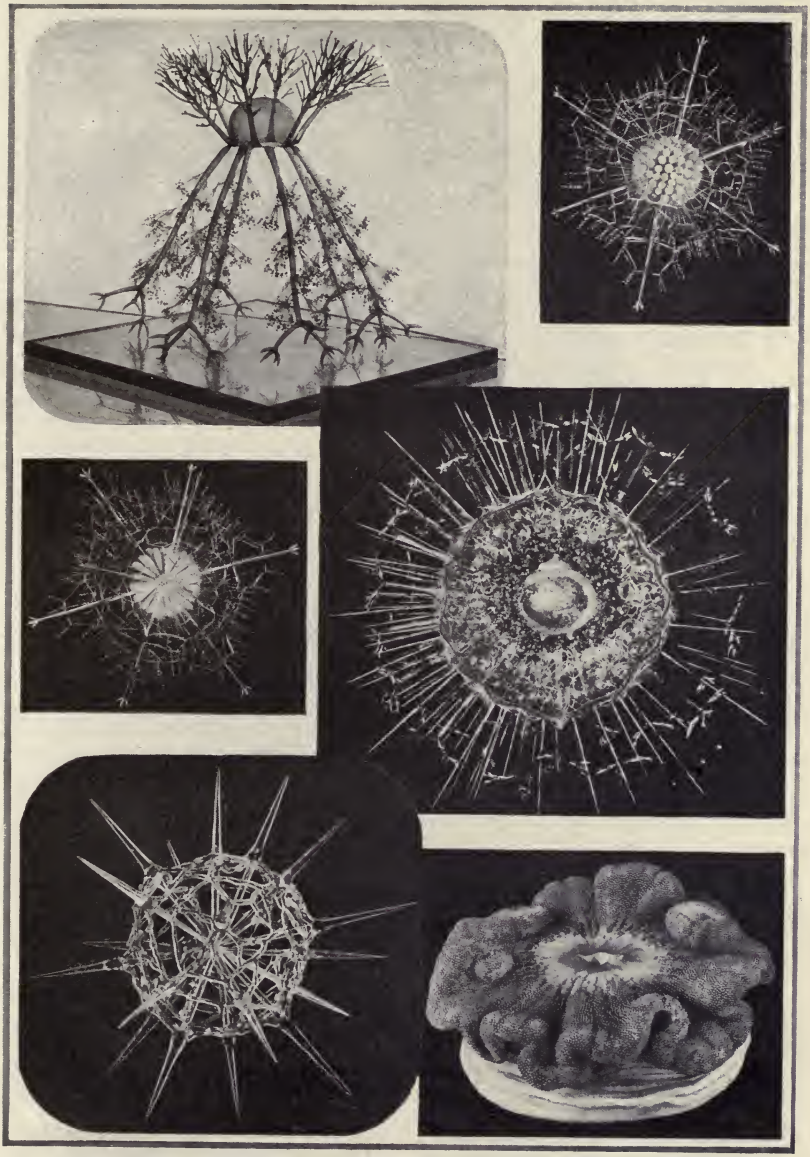
By Herbert Beardsley

THE latest and most realistic portrayal of miniature marine animals of the ocean depths—animals having wonderful and almost unbelievable forms—is by enlarged models of glass. In these beautiful and intricate models the highest development of the glass-worker's art has been combined with scientific knowledge, and the onlooker may rest assured that he is gazing at the actual wonders of the sea for the first time made visible to the naked eye.

The accompanying illustrations depict a series of the most extraordinary and unique of these elaborately made glass models recently installed in the Museum of Natural History, New York. The models are of crystal glass executed by Mr. H. Muller, under the direction of Mr. Roy W. Miner of the Department of Invertebrate Zoölogy. The originals belong to a class of microscopic marine animals known under the scientific name of *Protozoa*. They are, as a whole, considered the simplest and lowest in structure of all animals, being composed of a single cell, yet certain among them, known as the *Radiolaria* have forms of amazing complexity and great beauty. These minute one-celled animals form a group of immense importance both from a biological and economic standpoint. Swarming in countless millions in both fresh and salt water, and at times even in the bodies of other animals, they are the most abundant and most widely distributed form of life. Many of the smaller marine and fresh water creatures depend upon them for food, and among them may also be found some of the most important disease-causing parasites. The calcareous and siliceous skeletons sometimes become compacted into solid rock, and thus are of great geological and commercial importance, many extensive cliffs of limestone and chalk having been formed in this way. The siliceous skeletons form the so-called "Radiolarian ooze," which is the source of the "Barbados earth" used for polishing and grinding, and which forms no inconsiderable part of the Island of Barbados. Though this vast world of creatures is so important and surrounds us on every side, penetrating, as it were, all the interspaces between the larger forms of life, yet they are invisible to our eyes, and were it not for the compound microscope and enlarged models we would be ignorant of them except in their effects.



Two glass models of Protozoa found respectively in the Waters of the Japan Sea and off Australia.



A collection of glass models of deep sea life now on exhibition at the Museum of Natural History in New York City. Scientific knowledge, coupled with the greatest skill in glass working has made these models possible.

In graphically portraying minute animal life the glass model is of paramount value to science and education, for aside from its embodying attractiveness and artistic realism of detail, it preserves both form and color for all time, a thing heretofore impossible when employing wax or other material.

STEEL AUTO TIRE EMPLOYING PNEUMATIC PRINCIPLE

Savage, inventor of Savage arms, has invented and perfected a steel auto tire that has the same resiliency as the usual rubber tire. In fact, this new steel casing resembles nothing more than a coat of mail for use on an inner casing of the usual kind. The tire is particularly intended for use on rocky, mountainous roads where the usual rubber tire would be quickly cut to pieces. Before making this new steel casing public, the tire was tested out under most adverse circumstances in order to develop possible mechanical flaws. The structure of the tire consists of numerous small interlocking sections, combined to form a solid though flexible fabric. The tire has the same resilient properties as the average tire.

A View of the new steel tire, as well as a single section of interlocking pieces. The usual inner tube is employed, the steel pieces forming an outer covering.

ELECTRO-MAGNET AIDS RED CROSS

One of the most prominent features of the present European conflict is the amazing success of the Red Cross field corps. Considering the enormous number of men on the firing line, the fatalities are surprisingly low. This fact is due in a large part to the extensive degree in which the most improved and up-to-date surgical methods and appliances are being employed.

Advances made in surgery during the past few years are being utilized with remarkable results in the treatment of wounded soldiers. American surgeons, who have gone to the front, in particular, are performing frequent operations which, while not new to science, have been rare in the past. All this adds to medical knowledge. Through their efforts men who would otherwise be compelled to go through life, maimed and disfigured are being reconstructed physically, while at the same time those surgeons are obtaining experiences of such a varied character as would be impossible except in time of war.

Dr. Joseph Blake, of New York, at the American Ambulance Hospital, is making a new nose. Over an artificial ridge he is grafting flesh and skin from the wounded man's forearm. Surgeons at Val-de-Grace Hospital constructed a new chin of rubber, covered with a beard trimmed according to the soldier's photograph. In the American Ambulance Hospital a powerful electro-magnet is installed for removal of shrapnel, making unnecessary the long and difficult operation of probing. The X-ray apparatus is much in use for readily locating bullet wounds.

The Difficulties of Producing Films

By Ernest A. Dench

THE path of the film producer bristles with difficulties, especially when he has been refused permission to take pictures on certain sites or under certain conditions.

Some time back a certain producing company had set their mind on using Yellowstone Park and its charming scenic possibilities. They knew that cameras were not permitted to be operated therein, but this did not daunt them from attempting their object. Their apparatus was smuggled into the park and when the camera man was busy taking pictures, he was suddenly confronted by six soldiers and four mounted policemen, who arrested him and confiscated the film in the camera. They imprisoned him in the lock-up on the grounds for three days. Meantime he sent his credentials to the Secretary of State and these being proved, he was released.

In England the producer is mainly confronted by "red tape." No railroad plays are of British origin. This is due to the fact that in the early days of motion pictures the British railroad companies granted the use of a portion of their track to a film producer with fatal results. During the activities a man was killed. Since then the British railways have refused to co-operate with the cinematograph companies.

Last year the B. & C. Company—a British film firm—engaged part of a regiment of soldiers to play in "The Battle of Waterloo." Despite the fact that the army men were employed when off duty and their earnings increased the sport funds, the War Office expressed its disapproval in no small manner.

In those days when the police of England and the suffragettes were at odds, it was perhaps unwise for a large automobile party, consisting of a dozen girls dressed as suffragettes, the camera men and director, to attempt a raid on the Prime Minister's residence in Downing street, London. The police were on the warpath, however, and although explanations were forthcoming, they declined to allow the producer to obtain his much-desired realism.

Even when the motion picture company applied to the Commissioner of Works and the Prime Minister himself for official permission, they failed in their purpose.

But this state of things is not peculiar to England, for producers in other countries have similar difficulties confronting them.

In Germany no films must hold up the police or soldiers to ridicule, so when an officer of the law saw a man in policeman's attire flaunting a sword and revolver while chasing a desperate looking criminal in burlesque fashion, he prompt-

ly took both in charge. It was for the "movies," of course, but the pseudo policeman did not secure his liberty without paying a heavy fine.

On a previous occasion, just as an airship was leaving the aviation ground of the German government, an automobile dashed up and from it jumped an excited man who ran up to the occupants of the airship and begged them to stop. Before they could recover from their surprise he waved a batch of official appearing documents and boarded the car of the airship. He then ordered the flight to be started.

After the airship had proceeded a good way on its voyage, the man explained that he was playing the part of a detective in a film drama and as the firm producers could not obtain consent to board the airship by legitimate means, he had resorted to this method.

The "detective" attempted to bribe the officials, but they were so indignant at being misled in such a manner that they had him arrested on reaching *terra firma*. The unlucky actor spent the few weeks that followed in jail.

During the recess of the French parliament, a producer managed to secure permission to photograph the interior of the Palais Bourbon. But his real motive was to have his players made-up to represent the noted persons and have them act in the benches. Somehow the authorities got wind of the affair and promptly stopped the proceedings, to the dismay of the photoplayers.

STAGE IN THE OPEN FOR "DREAM" FILM

How the "dream or vision" is produced in a moving picture film is shown in this view. The fireplace is set up outdoors in order to secure a pretty landscape effect through the opening of the grate and the girl in the arm chair is supposed to be seeing herself and her lover in a mental picture. In reality, the girl in the chair with her back to the camera is not the heroine of the film, but instead she is an actress of about the same general appearance who takes her place for this scene; the leading lady being engaged in enacting the "vision." The section of film preceding this and showing the same grate with a burning log, is taken in the studio. The sudden transition from a fire on the hearth to a landscape in the grate makes a very pretty effect in the film drama.

Arrangement of a Set for producing a Vision in a Fireplace.

ACTOR HAS APPEARED IN 1,600,000 PICTURES

Director Arthur Mackley has begun work on his twenty-sixth picture for Reliance-Mutual release, in which he appears in the role of a western sheriff. The title of this picture is "Sheriff For An Hour," in which the western officer and deputies arrest a young crook who has been deceiving his mother by making her believe he was earning an honest living.

Since originating his part of sheriff, Mr. Mackley has played in almost 200 subjects, averaging 1,000 feet each, and appearing in almost half of the scenes. With sixteen pictures to each foot, his face appears in a total of 1,600,000 motion pictures.

Don't fail to read the important announcement appearing on page 289 of this issue.

Chameleon City

By Chas. W. Person

THERE'S no use trying to doubt the postulary perfection of the axiom that one never can tell. One never can!

A city is being built in the San Fernando valley—just a short trolley ride out of Los Angeles—that can be changed over night to conform to any nationality, style of architecture, color scheme or state of preservation. All the director of construction needs is a night's notice and he'll turn the town into an Illium for you, or a Rome, Athens, Paris, London, Chicago, New York or any really sizeable place you may mention.

And it won't be such a tremendous job for him, either, for this was exactly what the city was built for—to be changed over night into something radically different and changed back again with equal facility. When the plans for it were made the architects, landscape artists and engineers were told to keep this one idea uppermost—the greatest usefulness with the least amount of construction.

For that reason every building which has been put up or which is planned is designed to have a four or five fold usefulness. Every facade is of a different type of architecture and usually represents a different kind of usefulness. For instance, a shelter designed primarily for a saddlery shop and a blacksmithy has a front elevation that is in keeping with the nature of the building. From the other three angles, however, it has the appearance of a Gothic hunting lodge, military barracks, and a Wild West ranch house. In addition to this, any one of these front elevations can be changed over night to represent an entirely different kind and character of building. This idea will be carried out throughout the entire city.

You probably have guessed it by this time. The city is to be built for the express purpose of making moving pictures—the first and only city of its kind ever attempted. When completed it will accommodate 15,000 souls, and it will cost something like $2,000,000. The construction work has already progressed so far that a small settle-

ment is standing now and being used for motion picture work. Around this the greater city will be built.

It was only after careful consideration of all the localities within a convenient radius of Los Angeles that the San Fernando valley was chosen as the site for the city. Every advantage has been taken of the remarkable configuration of the valley to bring out the variety of backgrounds and locations. There is a natural lake and lagoon which has sufficient depth and size to float any craft from an Indian canoe to an American battleship, but undertaking than building a river bed. The idea has been to get a view of water, hill, vale and mountain scenery from the principal buildings in the unique city.

The plan of usefulness has been carried out in many particulars thus far. Viewed from one side the landscapes present a certain aspect. From the other side the character, climatic or sectional, is entirely different. This will enable a director, who under ordinary circumstances would have a certain number of good locations, to be able to construct from ten to thirty

In the Oval: A Portion of the Huge Outdoor Stage where "Interior" Settings are Photographed; Below: The Blacksmith Shop which is Kept Busy not only in Shoeing Horses but in Making Different Objects in Iron Required in the Production of Photoplays.

where natural water-ways are not found and are needed, they have been artificially constructed. There is a large force of men at present occupied in no less an more scenes from the same locations. Every stream and gully has been spanned by bridges and here is illustrated how changeable the complexion

Above: The Dressing Rooms for the Actors, which are Supplied with all Conveniences and Comforts. At the Right: One of the Buildings the Four Sides of which are Totally Different.

Above: The Carpenter Shop of the Chameleon City. There is no other Department of this Thriving and Hustling Community that has More Work to Accomplish than the Carpenter Shop.

of the city can be. Every bridge is so constructed that it can take on the appearance of a Japanese arch bridge, a Roman stone bridge or a steel cantilever bridge, or in fact any other kind of a bridge for which the director has need in the production of a scenario.

All the streets are to be scientifically paved and piped for gas, electricity and sewer mains. The main boulevard will be six miles long and this, taken in conjunction with other main streets and cross streets, will give an idea of the amount of work which the street department alone will have to do. The piping for water is an important item, for every building and house will be supplied with water 99 per cent. pure, fed to a reservoir from seven artesian wells at the rate of 300,000 gallons a day. The roadways of the city are peculiar in that they are being constructed in different widths and styles of top dressing, in order that the director may have a variety in the matter of road scenes.

For the convenience of both men and women actors, a club house is being built. For outdoor enjoyment, there is under construction a quarter-mile race track, with concrete grand stand and stadium in the most approved university style, and this arena can be employed for a setting in a play calling for outdoor sports, or for a number of different settings. One day, it may be necessary to use it for the Coliseum at Rome, and another day for the Olympic stadium in Greece. Some director may wish to stage a country fair there, another may wish to have it represent the Polo Grounds in New York City. It can also be used for an Indian Durbar or golf links. Just outside the stadium is a model tennis court built for utility and pleasure, combined.

There is now under construction an administration building, an exhibition theatre that can take on either the appearance of a city or country theatre at the behest of the director, barracks for the housing of a troop of cavalrymen, bunk houses for the cowboys and two hospitals and infirmaries, which will be thoroughly equipped with

every modern instrument for surgical and pathological remedy. Treatment in these hospitals will be defrayed by the company, and the bungalow residences within the city will be rented to employees far below the usual rentals in the vicinity of Los Angeles.

Above: A View of a Portion of the Chameleon City with a Partly Finished Building in the Foreground. At the Right: Huts of Various Designs for Use in Photoplays.

Below: The Grand Boulevard of Universal City, Lined on Either Side by Dwellings for the Employees and the Buildings that House the Various Departments of the Big Studio.

The wardrobe department has a building of its own now. It was one of the first to be built and contains a wardrobe valued at $35,000. In addition to this the costume shops, which are nearby, are so arranged that they can turn out the designs which are required by every period of dress from the era of palm leaf girdles to the present time. Twenty electrically operated sewing machines turn out the work.

The first notable incident of the mobility of this movie city was shown in the preparation very recently of a scenario. The director knew of just the proper location for a fire and a rescue by means of a rope acting as a pendulum, but sad to relate the scene was supposed to take place in Jersey City, New Jersey, and that was three thousand miles away.

It was out of the question to take a company that distance in order to stage that one scene, and even then the city fathers of Jersey City would not have consented to the total destruction of one of their office buildings even for the edification of ten million movie fans. The only thing to do was to reconstruct the scene from buildings already standing. This was done in thirty-six hours. The result was so perfect that New Yorkers who gazed upon it in wonder were compelled to pinch themselves before they could realize they were in California and not New Jersey. The scene was then burnt to the ground, and this newest and oddest of cities, the chameleon, once more resumed its workaday color.

The great feature film, "The Clansman," which has recently been completed, required seven months for filming, following eight weeks spent in the preparation of the scenario. The cost is estimated at from $300,000 to $500,000 and more than 100,000 feet of film was taken, although it was afterwards cut to 12,000 in the finished production.

THE ECLAIR WESTERN STUDIO

In the above view is shown a portion of one of the several outdoor stages of the Eclair Studio at Tucson, Arizona. Recently, Webster Cullison, managing director of the Eclair forces, came to New York City to arrange with the Eclair and Universal officials concerning the new producing companies to be formed and the new buildings and stages that are to be erected at Tucson, as well as the necessary equipment. While in New York he made arrangements with the owners of the steamer Palatial to take twelve van loads of furniture, properties, scenery and other equipment to Tucson.

On his return trip Mr. Cullison was accompanied by 32 players who were to form the basis of several new companies. These actors and actresses were in addition to the 27 then situated at Tucson.

Relative to the transporting of the entire production force of the Eclair to Tucson and of the closing down of the Fort Lee, N. J., studios for at least the time being, Mr. Cullison stated:

"I have known for a long time that the locality in which I am at present situated is superior to almost any other in the United States and I speak from personal experience as a director in nearly every part of this country. Above other considerations, Tucson has ideal climatic conditions necessary to the best photography, where daylight is depended upon. Of course, there is no question but that the sun is superior to artificial light for photography in Tucson. During my sojourn there as managing director of the Western Eclair Company we have had about six days of bad weather."

ESCAPE OF SNAKE CAUSES LIVELY TIMES AT WESTERN STUDIO

A big snake and a gila monster almost demoralized the Komic Company at the Reliance and Majestic Mutual studios in Los Angeles during the taking of "Dizzy Joe's Career."

Eddie Dillon, while directing the production in which he played the title rôle of "Dizzy Joe," was compelled to handle a big snake while acting as a snake charmer in a circus. The animal man who furnished the snake for the picture brought a gila monster with him. During the rehearsal the animal man turned the gila monster loose.

Dillon was barefooted and had a firm grasp on the snake. When the gila monster was seen free on the studio stage there was a wild scramble on the part of the players to beat a hasty retreat. Dillon dropped the snake, stubbed his big toe and ran a splinter in his foot beating a hasty retreat.

A short time later, when the gila monster had been recaptured, it was learned that it was perfectly harmless.

HISTORICAL KNOWLEDGE OF A DIRECTOR

They recently were staging one of the big battle scenes in "The Clansman" about forty miles away from the Mutual studios in Los Angeles when there arose a dispute among the actors as to the color and kind of horse ridden by the famous Confederate commander in chief, General Robert E. Lee, when he was campaigning at the head of the Army of Northern Virginia. D. W. Griffith, the well-known director, who alone is responsible for the production of this picture, was away for the moment.

"Better stop 'taking,'" said one of the actors to the camera man, "till we telephone in and have all the facts about General Lee's horse looked up and verified."

A high powered touring car had glided up behind the group. In it sat Griffith himself.

"What's the fuss about?" he inquired. When told he smiled tolerantly. "Why, Lee's dappled gray charger, Traveler," he remarked, "is one of the three most famous horses in history. Bucephalus and Napoleon's nags were the other two, and I've got a horse as near like Traveler as possible waiting in that stable yonder. Go on with your 'take.'"

SPARROWS INTERFERE WITH PRODUCTION OF PHOTOPLAY

It happened in the big Lubin studio in Philadelphia, just as Director Barry O'Neil was getting ready to stage the big climax in the feature film "District Attorney."

"Lights," shouted O'Neil. The powerful lights dazzled the room. "Camera," yelled the director. Both camera men started to grind and the acting began. Then, down swooped the two sparrows, just grazing Miss Bernard's head. All the players did a small stampede, thinking the sparrows were bats. O'Neil had to stop the scene. A few minutes later the players began again and once again into the scene swooped the sparrows. It was indeed a test for tempers, but not nearly as great a one as when the thing happened a third time. O'Neil was forced to wait fully three-quarters of an hour while everyone in the studio, armed with various domestic weapons, helped drive out the winged interrupters.

BARTERING FOR ADMISSION TO THE MOVIES

The natives in such places as Guam, in the Philippines and the South Sea Islands transact business by bartering instead of money. And since the popularity of the motion pictures has spread to these outlying places it has been up to the picture theatre proprietors to adjust themselves to the local conditions.

In Gaum the natives idled their time away until an enterprising American opened a cinema show there. They

then all suddenly went in for poultry farming. The reason for this was that ten fowls' eggs acted as an *open sesame* to the movies. As for the poor hens, they have had to work overtime.

Thanks to a Frenchman, there are now three film halls in Tahiti. Being the only form of amusement it has become very popular with the Tahitan. He will barter anything to obtain admission, even to his shirt or girdle, whichever he may be wearing. Every night the entire population—totalling about 8,000—swarms to the theatres which can accommodate 3,500 altogether.

To reduce the huge crowds, the exhibitor was obliged to increase the entrance fees. It developed into such a nuisance that the Governor ordered the places to close three nights a week. On the remaining four evenings a general stampede now takes place.

It is stated that the crime pictures are having a bad effect on the natives, so it is quite likely that there will be a censor soon.

FIRST PICTURE STUDIO IN THE UNITED STATES

What is claimed to be the first motion picture studio in the United States is illustrated in the accompanying view, showing the building erected by the Edison Company in 1905. It was built on pivots so that it could be swung around to follow the sun, and on a truck so as to be transportable from place to place. The building measured about 20 by 25 feet, and was familiarly called the "Black Maria" by the members of the company.

This Building is Said to Have Been the First Motion Picture Studio in the United States. Compared to a Modern Studio it would Not Even be large Enough to Shelter a Single Setting.

"SAFETY FIRST" PREVENTS DEATH OF AN ACTOR

Everything was in readiness and the real action was about to start for one of the scenes in the Universal serial, "The Master Key," featuring a man crossing a wire cable in a suspended bucket, when someone suggested that the cable should be tested before attempting to cross it. A weight of about

300 pounds was placed in the bucket and sent on its journey. Just as it reached the section of the cable over the deepest part of the canyon there was a sharp snap, followed by the breaking of the cable and the dropping of the bucket and its weight to the bottom of the chasm. The players looked at each other in amazement. Needless to state, if Robert Leonard, the leading man, had attempted the crossing of the cable under these circumstances, he would have been dashed to death.

CLEVER RUSE SUCCEEDS IN GETTING SCENE OF BIG CROWD

Richard Stanton, actor-director of the Ince forces on the West Coast, was recently confronted with the difficult problem of securing a scene in which many persons crowd about several newsboys who are announcing an important extra. According to the story, the extra tells of the election of one of the candidates.

After considerable thought, Stanton finally decided on a somewhat novel scheme. He had several boys don the garb of newsboys and sent them out on the boardwalk at Venice, California. Meanwhile Stanton and his cameraman concealed themselves in a nearby building. The large crowds at the resort were soon startled by the cry of the boys to the effect that England had declared war on the United States. Everybody made a rush to secure a copy of the newspaper; the camera recording the excitement. After the scene was taken, Stanton made a hasty retreat in order to avoid the fury of the crowd.

CRYSTALS — THEIR MAKING, HABITS AND BEAUTY

Few persons are aware of the beauty of crystals that may be formed from ordinary household materials. In a recent Edison release appearing under the above title, a youthful chemist is shown at work in the kitchen of his home performing interesting experiments with such common substances as table salt, epson salt and other similar materials. The crystals formed by these substances are shown in highly magnified views and in their full beauty.

EXHIBITION OF THE MAKING OF MOTION PICTURES

One of the many novel features of the Panama-California Exposition to be held at San Diego will be a demonstration of how motion pictures are made.

For the sum of two dollars the visitor to the exposition will be permitted to spend an hour and a half in a typical motion picture studio. At the opening of the performance the motion picture stage will be clear. At the instruction of the professional photoplay director the stage hands will make up sets; the actors and actresses will rehearse their parts, and, finally, the camera will be brought into action to record the play. A film will then be projected on the screen to show the process of developing, drying, printing and finishing the film. Lastly, a motion picture of the scenes made will be shown.

DEATH FALL OF AVIATOR IS FILMED

Unpleasant as the subject is, nevertheless it is worthy of note that a member of Thomas H. Ince's camera staff succeeded recently in filming the actual death of an aviator. The flying man's name was Thomas Hill. After he had risen in his monoplane at Venice and attained a height of 3,000 feet and was in the act of looping the loop, one of the wings of the machine buckled, and man and machine started for the earth at almost unbelievable speed. The aviator was killed instantly. A company of Ince's players was close by at the time of the accident, and a camera man quickly focused his machine on the spectacle, while the rest of those present watched with dumb horror the tragedy so swiftly approaching its climax

How Cut Glass is Made

By F. B. Jacobs

THE average person is of the opinion that cut glass is an expensive luxury, involving an endless amount of intricate manipulation in the course of its manufacture. This, however, is far from the truth, since cut glass is comparatively inexpensive when its artistic and decorative value is considered, and the process followed in its manufacture is quite simple and easily understood.

There are, broadly speaking, two kinds of cut glass. The most expensive, cut from plain blanks, and a cheaper grade made from figured or pressed blanks. To cut from plain blanks calls for high skill on the part of the workman, who not only has to be a skilled artisan, but an expert mechanic as well, inasmuch as a slight error in the judgment of minute distances would ruin several hours and, in some cases, several days' work.

Smoothing the Rough Cuts in a Piece of Cut Glass by Means of a Revolving Grind Stone.

Figured blanks are pressed in a mold while the glass is in a molten state. The desired design is cut in the mold and is thus imparted to the blank. A figured blank looks somewhat like the imitation cut glass seen on the counters of any department store. In finishing figured blanks it is only necessary for the workman to follow the depressions left by the mold which work, needless to state, does not call for the skill required to cut from a plain blank.

It is possible, however, to finish up figured blanks with a degree of skill sufficient to deceive anyone who is not versed in the art of glass cutting. For this reason, it is a good plan for the purchaser to exercise a little caution, following the practical suggestions here given. In the first place, cut glass made from plain blanks has a substantial appearance. Again, the inside surface of open work, nappies, finger bowls, berry dishes, etc., is free from wrinkles and waves. Further, the edges of the cuts are sharp. Lastly, work cut from plain blanks rings when snapped sharply with the fingers, while a piece cut from a figured blank gives a dull tone. The difference in tone is due to the fact that different grades of glass are used in making the blanks. Perhaps the main reason why plain blanks are used by the better class of cut glass manufacturers is that their use enables them to keep their designs exclusive to a great extent. This could not be done if figured blanks were used as the designs of these are originated by the blank manufacturers and naturally they are willing to sell the same design to as many cutting shops as wish to buy.

The first step in cutting a piece of glassware is to rough out the cuts on a roughing mill. This is a revolving iron disc with a miter turned on its periphery. The cutting is done by carborundum grain mixed with water. This flows on the mill in a fine stream. Some years ago sand was used for this operation, but experience has proved that carborundum cuts about twice as fast, thereby saving valuable time. The work is held against

the mill by hand, the workman being guided only by a few lines roughly painted on the glass. Great skill has to be exercised in guiding the work and, for this reason, several years of constant training is necessary before one can turn out high grade work in a rapid manner.

After the roughing operation, the cuts are smoothed as shown in the illustration. Until a few years ago, black craigleith, a stone found in Scotland, was used almost exclusively for this work. The event of the electric furnace, however, has furnished artificial abrasives that are rapidly supplanting the more expensive natural stone. These abrasives are practically pure alumina and are sold under the trade names of alundum and aloxite.

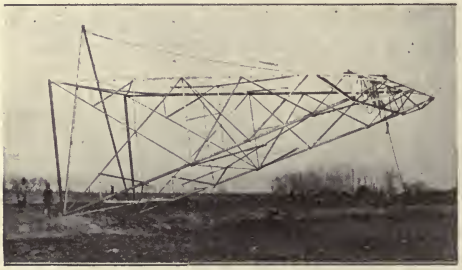
The next step is to finish and polish the cuts. This is done on a wheel made of poplar wood with its periphery turned to a miter to correspond to the cuts. The cuts are first gone over carefully with a fine powder solution having practically no abrasive qualities, after which the final polish is imparted with rouge. After washing and inspecting the ware is ready for shipment.

With the cheaper grade of ware the process is more simple. The impressions left by the mold are smoothed on an abrasive wheel, followed by a cheap finish imparted by dipping the pieces in an acid solution. This is known to the trade as "acid polish." It is seen that this method reduces production costs to a great extent, as two expensive operations are eliminated: the first roughing and the hand polishing. While acid polishing is generally associated with cheap ware, it is sometimes employed for the final finishing of high grade goods. In this case the surface of the piece is carefully coated with wax, leaving the cuts only exposed to the action of the acid. The object of the wax coating is to preserve the sharp edges on the surface.

The manufacture of cut glass is not a modern industry by any means, yet, strange to say, the work is done in the same manner that it was generations ago. The only real improvements are the substitution of carborundum for sand and artificial abrasive wheels for craigleith stones. To be sure, we might consider the acid polishing method as an improvement, as indeed it is, from the manufacturers' point of view. Its universal use by the manufacturers of the cheaper grades of goods, however, has had a tendency to lower quality.

BRINGING A TRANSMISSION TOWER INTO POSITION

This interesting view shows how a big steel transmission tower for a power line is brought into place. The structure is riveted together flat on the ground and cables are attached to it near the top. To these erection cables a team of eight or more horses can be hitched at their furthest ends. The two corners on the ground rest upon the foundations, and as the tower is swung upward, the other two corners land squarely upon the foundations prepared for them. This work is being done near Los Angeles, a city which is developing electric power at a surprising rate.



Eight or More Horses are Required to Erect a Steel Tower for Electric Cables.

A recent application of the electric current is in the form of an electrical apple wiper just placed on the market. It is said that with the aid of three men the machine will wipe one car load of apples in a day.

TELEPHONING WITHOUT WIRES

A system of telephoning without wires has been employed in German mines for some time past. Although the system cannot be considered as a wireless one inasmuch as there exists an actual conducting circuit between two stations, it possesses several novel features.

The system utilizes the pipes and rails of the mine to conduct an extremely high voltage current. The ordinary current at hand is raised to one of high tension that can readily be transmitted over piping and rails. It is said by the inventor that this high voltage current will not affect other nearby circuits nor will it produce a spark. Wireless waves do not interfere with the apparatus.

A commendable advantage of the system and indeed an obvious one is that connecting wires between stations are unnecessary. Another feature is that a general alarm may be sent to every station simultaneously in case of accident, while on the other hand the bell at each station can be operated separately through the employment of a special relay that is tuned to respond to a definite and individual signal. The instruments greatly resemble the usual wall telephone sets that are largely employed in this country. The transformer for converting low voltage current to high voltage current is an added feature. One type of instrument weighs but 20 pounds and can be installed anywhere convenient to rails or pipe lines. A pocket set that can be connected to pipes or rails for communicating with other stations, is also employed by the mine workers.

In Many German Mines a System of Wireless Telephony is Employed; the Rails and Pipes through the Mine Conveying the Current Between the Instruments.

EXTINGUISHING FIRE WITH BUBBLES

Just before the outbreak of the European war an experiment was made outside of Paris with a fire extinguisher which pours foam or bubbles over the blaze. In one experiment 16½ tons of benzine in a tank was set on fire and the foam extinguished it in a few minutes.

The new extinguisher is based upon the principle of pouring upon the blazing matter a blanket of thick foam, each bubble of which is formed of carbonic acid gas. This gas is incombustible and prevents the oxygen of the air from reaching the flames, thus suffocating the fire.

The foam that holds the gas is thick, adhesive and resists the air even when hot. It is the product of a mixture of two liquids kept separate until the moment they are to be used. The foam produced by bringing them together has a volume from eight to ten times as great as that of its generators. And the reaction that produces the foam also

generates the gas. Accordingly, the increase in volume is accompanied by a corresponding decrease in density. This makes it possible to project the foam from a nozzle at a considerable distance and with much less pressure than is needed for any liquid.

The generators are two, one for each of the liquids that are to be mixed. One of these consists of: glue, one part; glucose, a half part; bicarbonate of soda, 7½ parts, and one quart of salicylic acid, to 100 parts of water. The other consists of a 10 per cent. solution of sulphate of aluminum in water. When these two liquids are mixed sulphate of soda and hydrate of aluminum result, with a profuse liberation of carbonic acid gas. The glue and glucose form the foam and the salicylic acid acts as a dehydrant.

A hand apparatus of this type was tested recently under the following circumstances: In a room was placed a dressing table, with draperies above it, while celluloid combs, soap boxes and a mirror were put on the table. To the right and left were chairs covered with muslin slips, and below was a wicker basket full of paper. Above was a window casing draped with damask curtains, lace hangings and a paper fly trap. This collection of inflammable stuff was set on fire and allowed to burn for one minute. Then the extinguisher was opened and in 25 seconds the blaze was out.

BALLOONS AID IN WEATHER FORECASTS

A number of scientists have recently used balloons in making experiments at the weather station at Avalon, Catalina Island in the Pacific Ocean, thirty miles off the Californian coast.

Two rubber balloons fastened together are used for this purpose, which, when inflated, measure about twelve feet in diameter. A small instrument known as a meteograph is sent up in a basket attached to these balloons. As they ascend and the air becomes lighter the gas expands the rubber and finally one of them bursts and the weight of the meteograph brings the other balloon slowly earthward and deposits the instrument on the ground. If the instrument falls on water its buoyancy keeps it afloat. There is a liberal reward offered for the return of these instruments, so that the weather bureau usually gets them back within a short time.

Scientists using an Instrument for Measuring the Height of the Balloons Carrying a Meteograph.

The device consists of a small aluminum cylinder blackened with camphor smoke and on which the records for humidity, altitude and temperature are traced by means of three needles. One of these instruments recorded an altitude of eighteen miles, indicating a temperature at eight miles 85 degrees below zero with little variation up to the eighteenth mile altitude. Intense cold prevails a few thousand feet above earth.

Here are some of the things sought for by these scientists:

The height of the sea breeze.
The lateral thickness of the breeze.
The thickness of the clouds.
The temperature above the clouds.

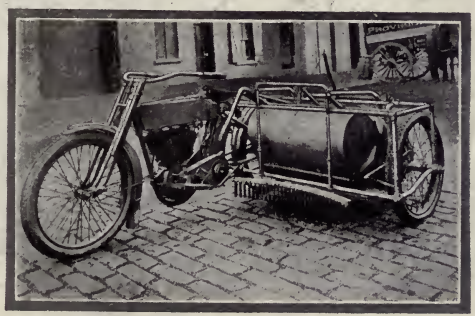
By studying the upper air currents beyond the influence of the mountains and local peculiarities the scientists hope to learn the general conditions of the great movements which produce storms and fair weather.

MOTORCYCLE FOR STREET CLEANING

Although originally a pleasure vehicle, the motorcycle is rapidly finding useful employment in other fields. One of the most recent applications is for street sweeping, the motorcycle being fitted with a side car as shown in the accompanying illustration. The equipment comprises a water tank for watering the streets, as well as a broom for sweeping.

The street cleaning attachment is so arranged that the levers controlling the flow of water and the pressure of the broom on the street surface can be readily reached by the motorcycle driver.

The motorcycle street cleaner is expected to prove a great boon to villages and small towns which cannot afford the larger and more costly machines used in the big cities.



A Motorcycle fitted with a Street Cleaning Attachment.

It Required Three Weeks to Scrub the Walls of this Church from Top to Bottom.

CHURCH RECEIVES A BATH

Human beings, animals and statues usually manage to get a bath quite often, but it is seldom a building receives a good "wash." Nevertheless, it was the fate of this edifice in Boston to be scrubbed from top to bottom recently and the old yellow and gray paint, which had been on for over seventy years, was washed off by a score of men, disclosing the finely laid masonry of the period of 1810.

The operation took the best part of three weeks and was watched by many thousands of interested people.

A present-day English play has for its plot a wireless installation in a chimney, which has been ridiculed. Yet recently a wireless outfit was discovered in a chimney by the Liverpool police.

A British Hospital Train

THE Midland Railway Company of England has recently supplied two military ambulance trains to the War Office. Each train comprises nine buggy vehicles and a six-wheeled kitchen carriage. The cars were all taken from regular traffic service and converted and equipped for hospital service at the railway works at Derby.

The train consists of five hospital wards, sleeping accommodation for medical officers, nursing sisters and the staff; special compartments for a pharmacy, a treatment office, provision stores, linen stores, and a store room for men's kits. All the carriages have clerestory roofs and are connected by communicating vestibules.

Each train is assembled in the following order: Sleeping and lavatory accommodation for two R. A. M. C. personnel and two medical officers; mess compartments and pantry for two medical officers and two nurses; sleeping and

Photos. Janet M. Cummings.

Sleeping quarters for the wounded, showing the arrangement of the berths. This car will accommodate twenty men.

lavatory accommodation for two nurses; kitchen carriage fitted with complete cooking range, etc.; provision stores, wash up pantry and special meat safe; mess, sleeping and lavatory accommodation for ten R. A. M. C. personnel; hospital ward for four officers and sixteen men; hospital ward for twenty men; pharmacy, treatment room, stores for clean and dirty linen; office fitted with small safe, shelves, etc.; three hospital wards for twenty men each; sleeping and lavatory accommodation for R. A. M. C. personnel, and accommodation for men's kits, etc.

The cars have been arranged with central corridors and side entrances for the easy manipulation of the British War Department's standard stretchers.

The cots used in the hospital train are of the folding type, arranged in upper and lower berths, and fitted with wire mattresses.

One of the many interesting features of the train is a water storage reservoir which contains about 1,000 gallons of sterilized water for medical use.

The floors of the cars are covered with lead and rounded off to facilitate cleansing. The treatment room in addition has the walls lined with aluminum to a height slightly over three feet. The other floors of the vehicles are covered with linoleum.

The treatment room is provided with special sliding doors to permit of the ready passing of stretchers from either end of the train. The room is provided with shelves, table, racks and cupboards, as well as water and special lighting facilities.

All the cars of the hospital train are efficiently heated by means of steam from the locomotive and the temperature can be adjusted to suit the needs of the medical staff.

The above views in the order shown are: Pharmacy compartment, the treatment room, and a sleeping compartment with the cots folded and the same view with the cots in position for use.

MINIATURE DREADNAUGHT THAT IS PERFECT IN EVERY DETAIL

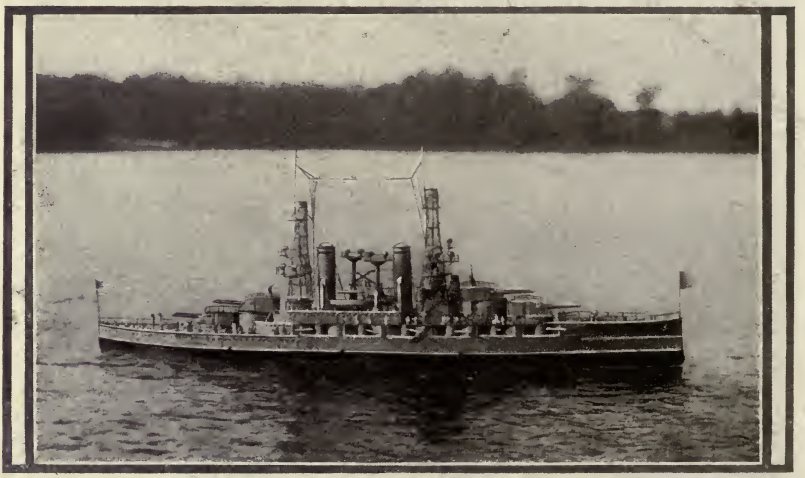
The accompanying illustration shows the toy superdreadnaught Massachusetts, propelled by electricity. It carries a full complement of guns and is manned by dummy crew. With a trail of smoke coming from her smokestacks, her turret guns firing a broadside, sailors marching along her decks and the band playing the "American Patrol," the toy superdreadnaught Massachusetts sailed her course on the waters of Spy pond, Arlington. With her "Jack" snapping in the wind, she moved along at her full speed capacity of fourteen miles an hour.

On the shores of this expanse of water a moving picture operator trained his camera, and reporters were much in evidence. Wild excitement prevailed among the crowd of youngsters who watched the Massachusetts majestically sail into port. This toy ship is a model of its namesake of the United States navy, and is thirteen feet long. It has been constructed by a young Boston jeweler.

The toy battleship is propelled by electric power. An intricate clock device causes the electric current to drive the triple propellers, fire the full complement of guns, march the dummy crew up and down the decks, raise and lower the anchors and flags, and play a phonograph. Every part of the American dreadnaught, even to the smallest detail, has been faithfully reproduced in this model.

One of the interesting features of the toy Massachusetts which is in advance of the regular warships is the installation of aeroplane guns that can be fired by the automatic arrangement.

The tiny Massachusetts is made entirely of steel. The lines of the model are as graceful as those of the speediest boats. She has a wireless outfit and fighting masts, duplicates of those on the American battleships. Other equipment includes a real wireless, searchlights, aeroplane guns, the Ardois signalling system and an automatic steering device. The main battery carries twelve miniature 14-inch guns, while the secondary battery has twelve 6-inch guns and four rapid firing guns.



A model of the superdreadnaught "Massachusetts," built by a young Boston jeweler. This model is a faithful replica of its namesake, even to the minutest details.

There are also six torpedo tubes.

The displacement of the toy craft is 750 pounds and the draft is 9½ inches, while the speed is fully 14 knots an hour.

VANDAL ELECTRICITY INJURES PIPE LINES

Because the abutting ends of the rails of one of Seattle's street car lines were not properly bonded when laid, the current strayed into the ground, flowed along pipes and caused serious damage to them. In one case a fire main was eaten away to such an extent that the water had to be turned off, and shortly afterwards, a frame building in one of the outlying districts was burned to the ground because of the lack of water.

The stray electric currents from street car rails are, in some instances, sufficient to melt a steel file.

Several interesting tests were made with the various pipes to show the amount of damage done. One section of steel pipe, when removed from the ground, was found to have been so rotted by electrolysis that iron spikes could be readily driven into it.

The accompanying view shows one of the large steel water mains running parallel to the street railway. A copper cable was attached to the street car rail and led to a steel file. So powerful was the current which was escaping that the file, when touched to the pipe, melted and flowed like water. Seven hundred amperes was the enormous strength of this vandal current.

The old-time and familiar hand lantern of the trainmen on many railroads is fast being replaced by electric lamps. The latter are designed after the same lines as the oil lanterns, the batteries being carried in the base of the lamp.

THE GUARDED MANUFACTURE OF BANK NOTES

One of the great considerations in the manufacture of bank notes in the United States Bureau of Printing and Engraving is to guard effectively against the possibility of counterfeiting or theft.

The paper is made in a private paper plant which manufactures this particular kind for none but the Government. It is made of cotton and linen rags in which are mixed the silk threads which may easily be seen by holding a bank or treasury note to the light.

The printing and engraving process through which the paper is put is a very elaborate one and requires very complex machinery. The machinery used is so accurate and so well fortified against successful imitation as to render both the means and the product practically beyond undetectable imitation.

The ink used is made in the same building where the work is done. One large room of the building occupied by the Bureau of Printing and Engraving contains something like a dozen large paint mills which are kept busy grinding together the colors and the oil used on the presses. Only the best materials are used in the manufacture of this ink for bank notes and postage stamps.

The sheets on which currency is to be printed are counted when received. They are issued to the workman on an order from the superintendent and are charged to that workman in a pass book provided for the purpose. When the printing is done the printer makes the impressions up in books of one hundred each, with brown paper placed between them. These are delivered to a clerk and the workman is credited with their delivery on his pass book.

Some sheets may be spoiled, but all are credited to him so that his book may balance.

These impressions are counted and inspected. Spoiled ones are destroyed by properly authorized agents. The perfect ones are dried, pressed, and again inspected and counted. They are then cut and delivered for issue.

POWER DIRECT FROM THE COAL-BEDS

One of the foremost men of science, Sir William Ramsay, has proposed a method of getting light, heat and power from the coal-beds by converting the coal into gas at the foot of deep borings. His plan is to set the coal on fire by electricity and then to pass air and water down through the tubes to make the gas. By burning this, electric power for lighting and heating and for operating the English railways can be produced at the mouth of the borings. The only fuel that would then be needed would be oil for ships. Of course, there would be losses of power in transmission over long distances, but these would not be excessive.

AN AERIAL TROLLEY CAR

Although suspended cars have been used successfully in Germany for a number of years, many new features have been devised in the aerial trolley system at Burbank, California.

The car is torpedo shaped with a framework of steel covered with aluminum. It is fifty feet long and seats fifty-six persons. It has carried capacity load with ease.

The chief difference between this and other aerial cars is that it is driven by a six foot propeller of unusual construction, having two fan-shaped blades of sheet metal on ribs of steel tubing.

Two views of the aerial trolley car designed and constructed by a Californian inventor. The suspended vehicle is driven by a gasoline engine connected to an aerial propeller.

To serve in case of accident to the propeller and engine on the back of the car, a second propeller and motor will be placed on the front. This can only be used to double the power, if desired, or to hold back on down grades by reversing its motion.

This unique propeller is far more efficient than the kind used on aeroplanes because of its large surface. It is operated by a four cylinder 25 h.p. gas engine such as is used in automobiles. The

propeller is capable of one thousand revolutions per minute and on a long stretch of track it is claimed that the car can easily make one hundred miles an hour.

The track in use at present is six hundred feet long and is built on the estate of the inventor, Mr. J. W. Fawkes. These tracks are supported on posts, some of steel and some of wood, with cross beams to correspond. This is in order to test both kinds.

The rails used are steel T beams three and a half inches broad, and three-eighths of an inch thick and scientifically trussed to prevent sagging. The car is held securely to the rail by means of four sets of grooved wheels firmly clamped both above and below the rail so that there is no danger of it jumping the track.

Another interesting point is the tilting planes to lighten the car by air pressure when it is in motion, as well as an apparatus to lower and raise the cars at the stations.

It is claimed that this trolley line is much more economical to install, costing approximately $2000 per mile and $1500 for each car. It has many advantages over the old systems, as it can be built over hills and across rough country as easily as on level stretches, the height of the track being regulated by the length of the pole. In fact, part of the Burbank system crosses a ravine by means of poles of various heights.

Mr. Fawkes is now considering the building of a double track line between Los Angeles and one of the suburban towns. For commercial purposes his idea is to have a five track system, the lower tracks for local transportation while the upper one is for a "flyer."

NEWLY INVENTED GAS TURBINE OF LIGHT WEIGHT

A gas turbine of exceptionally high power and efficiency, combined with the greatest fuel economy, has been developed by Josef Brandstetter, a young Austrian inventor living in Los Angeles. It is an exceedingly light and compact machine.

The inventor claims for the new gas turbine a number of features that should make it a factor to be reckoned with in modern power development. Great simplicity, with only one moving part, is perhaps the prime advantage, followed by the elimination of superfluous parts, making for extreme lightness. A 100 h.p. engine of this type would have a weight of only 90 pounds. The fuel cost can be reduced to 1/10 or even 1/20 of the expense for running a standard type gas engine, as it not only requires less fuel but will burn cheap crude oil. Overheating, the great difficulty to be overcome in gas turbines, has been done away with in this machine by a secret process. The inventor claims that the lightness of the engine, its simplicity of operation and absence of vibration will fit it for use in aeroplanes and motor vehicles, while its power producing qualities will make it available for large stationary engines.

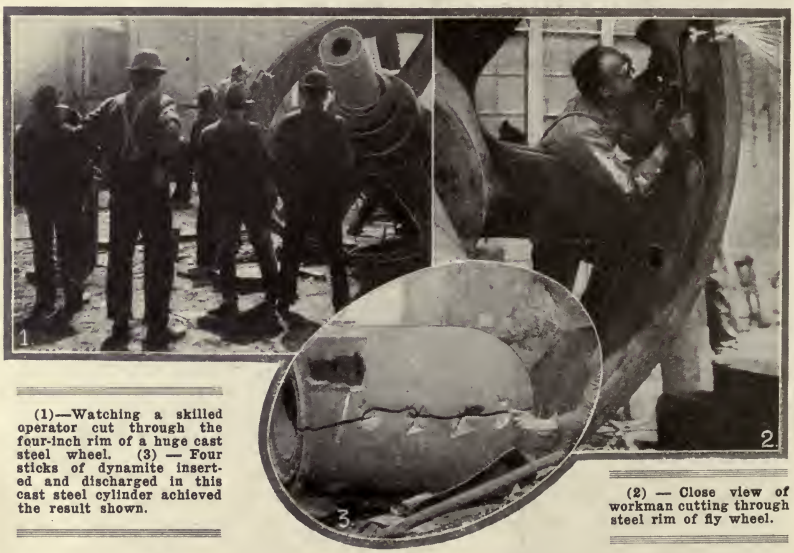
A working model of a gas turbine which possesses many promising features.

Eating Through Steel with Fire

By L. R. Perry

"LIKE cutting cheese with a razor, or butter with a hot knife," is seemingly a good way in which to describe the operation of the modern method of cutting through hard metals. The marvelous work of the once wonderful high-tempered steel saw has, of late years, become dwarfed before the truly phenomenal ability of the new oxy-acetylene blow-torch. So powerful, so easy of operation, and so practical for numberless purposes is this latter process of cutting that it has become a common one, and in many places an altogether used method, having rendered obsolete former methods now considered intolerable for the same purposes.

The process itself is quite simple: Two highly compressed gases, oxygen and acetylene, are drawn from two separate tanks, conveyed through pipes and allowed to issue from the same tiny nozzle. The issuing combination is set aflame and directed against the material to be severed, which it burns or melts within a limited space, thus causing a groove or cut. So localized is the work of this wonderful flame in the hands of a



(1)—Watching a skilled operator cut through the four-inch rim of a huge cast steel wheel. (3) — Four sticks of dynamite inserted and discharged in this cast steel cylinder achieved the result shown.

(2) — Close view of workman cutting through steel rim of fly wheel.

(1)—What an ineffectual discharge of dynamite did to the hub of a big steel wheel. (2)—Another view of the same wheel after being shattered by the dynamite discharge placed at the hub. (3)—Remarkable straight fracture of the cast steel wheel at the hub, caused on the opposite side to where the dynamite was inserted. (4)—Another view of the steel wheel and its shaft. (5)—An unsuccessful attempt to shatter the wheel by a dynamite blast.

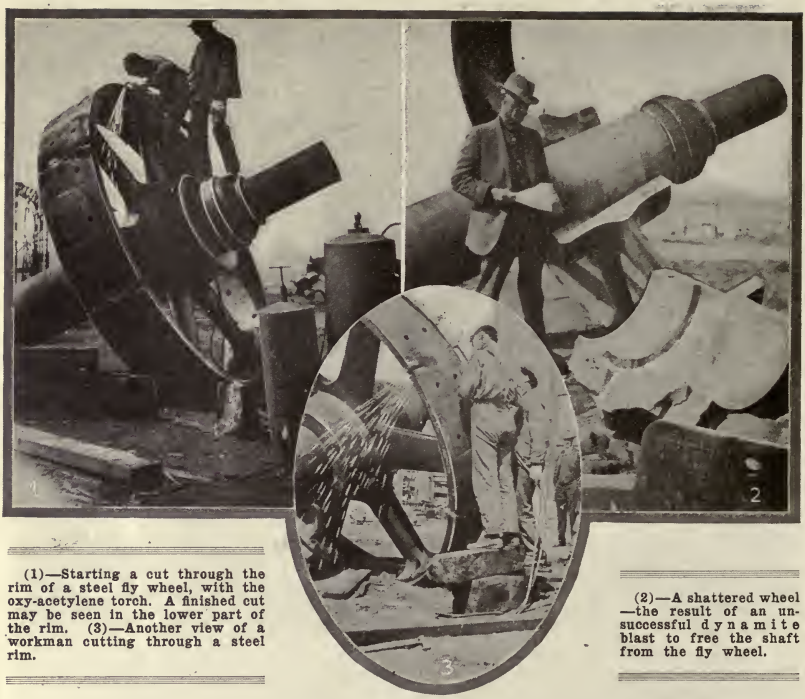
skilled operator that neat designs may be worked out or narrow slits in thick pieces of metal formed. And the ease with which the attacked metal is melted and forced away is comparable to the effect of a powerful stream of water from a hose washing away a bank of earth.

One of the chief features of the method is its portability, the apparatus often being seen nowadays on high parts of structural steel buildings where the trimming off of a girder is being accomplished in the twinkling of an eye. The reason that steel melts before the oxy-acetylene flame is because the temperature produced is several thousand degrees Fahrenheit, and steel melts in the neighborhood of 3,500 degrees.

Shopmen, too, now make a business of cutting out designs from sheets of steel, using guiding arrangements which accurately guide them over the geometrical forms of the flames.

Aluminum tanks, pipes, and other metal products for brewers' and chemical manufacturers' use are flame welded. Nickle is now being successfully handled.

Cutting tools are being made from low-carbon steel by changing the structure in the oxy-acetylene flame. Bases for oil-engines, automobile engine cylinders, boiler tubes, and ornamental iron-work are in the commercial stage of manufacture now. A still newer use is that of cleaning boiler tubes of scale by a modification of the oxy-acetylene flame, the heat being applied directly to the scale and causing it to become detached from the



(1)—Starting a cut through the rim of a steel fly wheel, with the oxy-acetylene torch. A finished cut may be seen in the lower part of the rim. (3)—Another view of a workman cutting through a steel rim.

(2)—A shattered wheel —the result of an unsuccessful dynamite blast to free the shaft from the fly wheel.

boiler by the expansion of air or moisture between it and the plate.

Welding processes have been absolutely revolutionized by the oxy-acetylene flame. Broken machinery has been put together in stronger form again without removing it from its bed; the great money and time saving advantages of the method having been instrumental in causing it to become quite popular with operators of big plants.

Flame welding is now said to cost but forty or fifty per cent. of riveting on the same piece of metal.

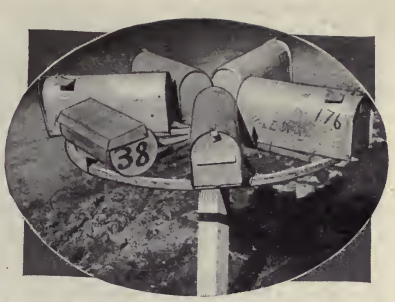
Several of the accompanying illustrations depict how dynamite was unsuccessfully employed in breaking up huge castings of electric generators relegated to the scrap heap. Holes were drilled in certain vulnerable parts of the huge castings, and dynamite inserted and exploded. The work proved slow, uncertain and ofttimes a failure. The oxy-acetylene torch was finally brought into play and the ponderous castings cut up into many sections in the minimum of time.

Plumbers, and pipe layers particularly, are now installing entire piping systems without threaded joints. Miles of pipe have been laid with far greater ease, speed and perfection by melting steel about the ends of long sections previously put together above ground in the manner described.

OLD WHEEL SERVES TO HOLD MANY MAIL BOXES

The "wheel of mail" is the very latest achievement in the way of a rural mail box holder. It consists of a regular, old-fashioned wagon wheel of the

wooden spoke type, supported upon a post 2 by 6 inches in size. Out of the upper end of the post a strong iron spike extends, and over this spike the hole in the hub has been placed. Upon reaching the wheel the owner of one of the boxes has simply to turn the wheel until his own box is brought around to his side. The mail is then taken out and the owner passes on. The boxes have been so arranged upon the wheel as to maintain the wheel in a horizontal position at all times. This affair was built by a number of families whose homes were located in a short lane just off the regularly established rural mail service. Rather than have their boxes scattered at different points around the intersection of their lane and the main road, they erected this very attractive and serviceable mail box holder.



A novel use for an old cartwheel is to use it as a revolving mail box stand.

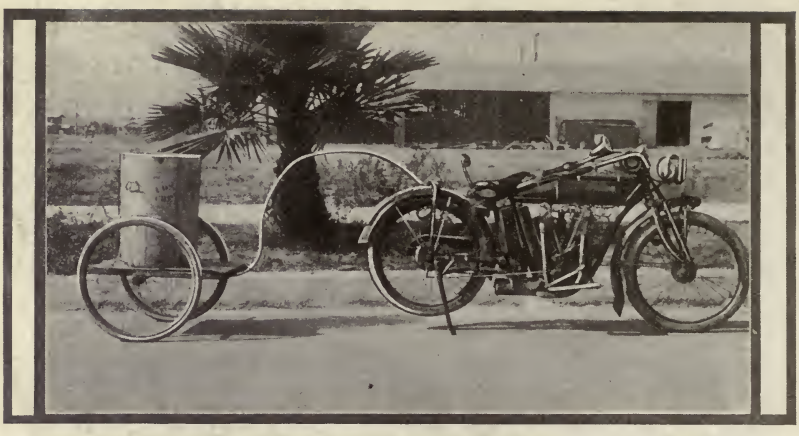
AN ELECTRICAL PICNIC DE LUXE

To show just how adaptable the electric current really is and to incidentally obviate the unpleasant task of cooking over a smoky bonfire, the employees of the Seattle Municipal Electric Company recently gave a picnic, the cooking for which was all done on the picnic grounds with electric heating utensils.

Wires were run through Woodland Park, where the festivities took place, from a near-by power line, and with the superintendent as the head chef, the meal was prepared. Beans were baked in an electric oven, and coffee was made over electric grids.

Electrical picnics are far better for the digestion than the old fashioned variety, although perhaps not so picturesque.

An electrical picnic in which the food was entirely prepared with electric devices—perhaps not as picturesque as the usual picnics, but certainly a greater success from a culinary standpoint.



By means of a light, two-wheeled cart, the motorcycle may be employed to good advantage for the delivery of merchandise.

A MOTORCYCLE TRAILER SOLVES DELIVERY PROBLEM

Using a small trailer, such as is shown in the accompanying illustration, for the transportation of ice cream pails is the idea of a Californian. This little vehicle has eliminated much of the inconvenience of delivering ice cream pails, aside from the rapidity of delivery over long distances. Originally, the motorcycle was used by its owner for the delivery of drugs and other items found in a drug store. It was accordingly a simple matter for its owner to attach the two-wheeled trailer which will accommodate one extra large keg or four medium sized kegs.

GOLD PENS

The bit of white metal seen on the under side of the point of a gold pen is sometimes platinum, but oftener iridium. Iridium is a very hard metal and a very expensive one, since it costs about four times as much as gold. The purpose of the iridium tip is, of course, to afford the pen a more durable point.

Manufacturers of gold pens obtain their gold from the assay offices in bars of pure twenty-four karat gold, which they melt and alloy with silver and copper to the degree of fineness required. Gold of fourteen karats is used in the making of the best American gold pens, that being the degree of fineness deemed most suitable for pen use; but good pens made in this country for sale in France are of eighteen karats, the French government requiring that all articles made of gold and offered for sale in that country shall be not less than eighteen karats.

The gold from which the pens are to be made is rolled and re-rolled until what was originally a thick, heavy bar of gold has been rolled into a thin gold ribbon about three feet in length by four inches in width. This gold ribbon is put into a machine that stamps out of it flat pen shapes. On the top of each of these shapes is fused the iridium point, the shapes then proceeding to a slitting machine, which cuts the slit in the pen. From this machine the pens go through another, which gives them their rounded, familiar pen form. Finally, they are ground, polished and finished, ready for use.

American gold pens are not confined to use in fountain pens. They are also made for use in regular pen holders, and have been sold in competition with those of British and English manufacture in South America, Africa, Japan, China—and wherever pens are used.

THE HARNESSING AND USE OF EXHAUST STEAM

It was in 1894 that Sir Charles Parsons showed that by means of the steam-turbine, exhaust steam from reciprocating engines could be used to produce power more economically than it had been produced before.

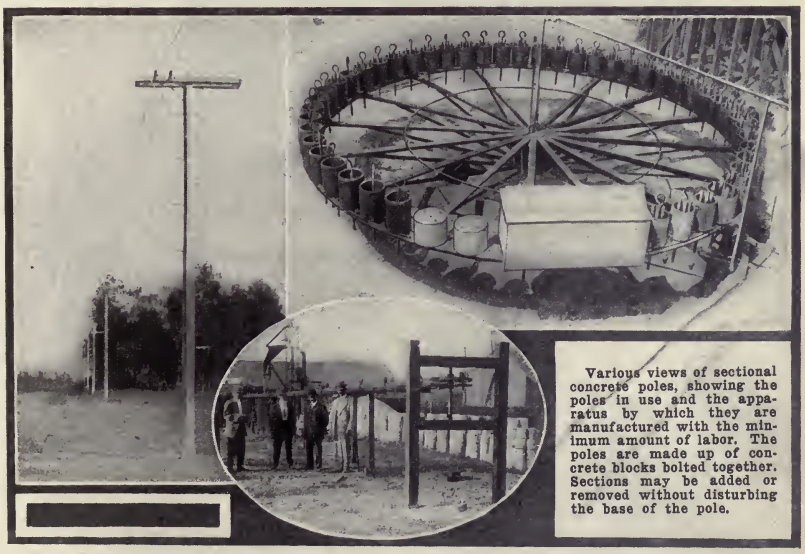
In 1901 Professor Rateau, of the School of Mines in Paris, discovered a method of using exhaust steam from engines that run intermittently. According to a high authority, the practical result of the development of exhaust and mixed-pressure turbines had been that, on land alone, nearly 2,000,000 horsepower of electrical energy is being generated by means of exhaust steam that had been previously wasted.

REINFORCED CONCRETE TELEPHONE POLES IN SECTIONS

A firm at Ahaheim, Cal., is manufacturing a reinforced concrete telephone and telegraph pole which can be made for sixty cents a foot and which can be enlarged or shortened any time after it is set up in the ground, without taking it down.

The poles are made by bolting and cementing cylindrical blocks together which are nine inches high. A telephone company may erect a fifteen foot pole this year and extend it to sixty feet next year by adding blocks to the top of the pole. The diameter of the blocks composing the pole vary to suit the size of the pole and the various strains to which it will be subjected.

Special moulds, containing stands for the reinforcing steel bolts which run through the center of the blocks, have been made and patented by the concern making the poles. The metal moulds are arranged on a revolving wheel that can be turned to suit the convenience of the operator. This contrivance saves him unnecessary walking, both in setting up the wet concrete and in



Various views of sectional concrete poles, showing the poles in use and the apparatus by which they are manufactured with the minimum amount of labor. The poles are made up of concrete blocks bolted together. Sections may be added or removed without disturbing the base of the pole.

collecting the blocks after they are cured. The wheel is also provided with automatic sprinkling devices by which the blocks may be moistened with water while they are curing.

WORTHLESS LAND RENDERED VALUABLE BY STAIRWAY

One of the novelties in the building line in Southern California is the hillside residential section located at Edendale and shown in the accompanying illustrations. This is an example of how an apparently worthless piece of steep, hilly land may be turned into an income-producing home section. The cement stairway, or rather series of stairways, consists of four sections of steps and three stretches of inclined walks, each of which is about a hundred feet in length, the whole having a length of something like seven hundred feet, this continuing directly up the side of the hill. The pretty little bungalow homes, which range in value from $1,200 to $1,400, have been erected along either side of the cement walk. The steps are about twelve feet in width, while the walk sections consist of two cement strips four feet in width and a four-foot parking between.

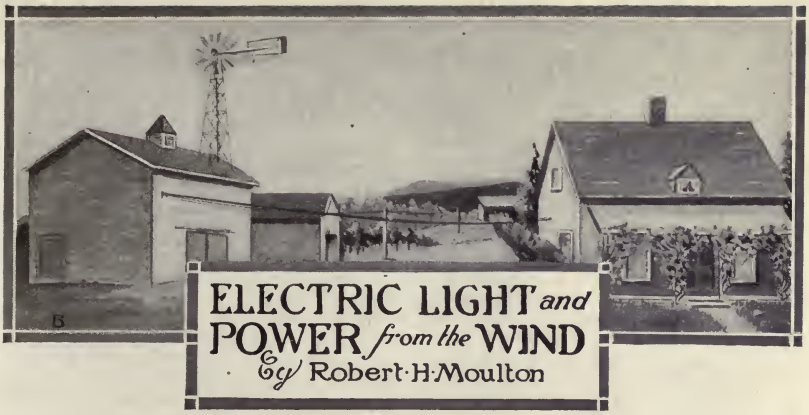
By building a concrete stairway, waste hillside land was rendered valuable.

HOT WELL INCUBATES CHICKS

A rancher in Mecca, Imperial County, California, has devised a method of turning to account the hot well upon his property by using it as an incubator. About the mouth of the flowing well he built a cement box and in this the incubator was placed with a little sand in the bottom on which the eggs are set. The receptacle is about two-thirds submerged, and the water circulates about it in such a manner that the eggs are kept at an even high temperature. The results have been unusually successful, as about 96 out of a hundred eggs are hatched.

MOLYBDENUM IN ELECTRIC LIGHTING

Not content with the improvement in the incandescent electric lamp brought about by using drawn wire filaments of tungsten instead of carbon, electrical experts are seeking an even more efficient metallic filament. It is said that molybdenum may supply the want. Molybdenum seems to be the most promising of all the so-called rare metals at all suitable for use in electric lamps. Molybdenum has rarely, if ever, been melted. Consequently, filaments of the pure or the alloyed metal could be used at a higher temperature than tungsten. That would mean better lights, for the efficiency of an electric lamp largely depends on the temperature to which the filaments can be raised. Molybdenum is a white metal, almost as malleable as iron. It can be forged while hot and worked up into thin rods, which in turn can be drawn into wire. Experts are now principally concerned with the problem whether the wire can be drawn sufficiently fine for the purpose.



ELECTRIC LIGHT *and* POWER *from the* WIND

By Robert H. Moulton

THE experiments of Mr. Forrest are of more than passing interest, offering as they do, a graphic proof that the windmill generator of electricity is an accomplished fact rather than a mere fancy.

A FEW years ago Thomas A. Edison made the prediction that in 200 years, due to the cheapening of commodities, the ordinary laborer will live as well as a man does now with $200,000 annual income. Automatic machinery and scientific agriculture will bring about this result, said Mr. Edison. Among devices for conserving power which is now more or less wasted, he mentioned the use of wind mills connected with storage batteries for laying up the energy of the winds in electrical form.

Since these statements were made the practicability of the wind mill electric generator has been thoroughly proven by at least one man, J. F. Forrest, of Poynette, Wisconsin. To a 12-foot power wind mill on his farm, Mr. Forrest has hitched a dynamo. This, in connection with a storage battery, converts and stores the energy of the wind into that of electricity. The amount thus rendered available is sufficient to light a system of 25 lamps distributed throughout the house and barn, and to operate various household and farm utilities.

After two years' experience with an unusual amount of calm weather during two summers, Mr. Forrest has at no time been without light. His power windmill is twelve feet in diameter and is geared up; that is, the vertical shaft makes five revolutions to one of the wind wheel. This shafting extends down the center of the tower and has pulleys, bevel gears and grinder rings attached to it. This windmill is used exclusively for power, as it has only the rotary motion. There is a pumping mill on a well nearby.

Right along in the line of economy, this windmill runs a drill press, grindstone, corn-sheller, bee hive saw, washing machine, grain elevator, feed grinder and the generator which charges the storage batteries. A power windmill, Mr. Forrest finds, will run any of these machines just as successfully as any pumping mill will run a pump.

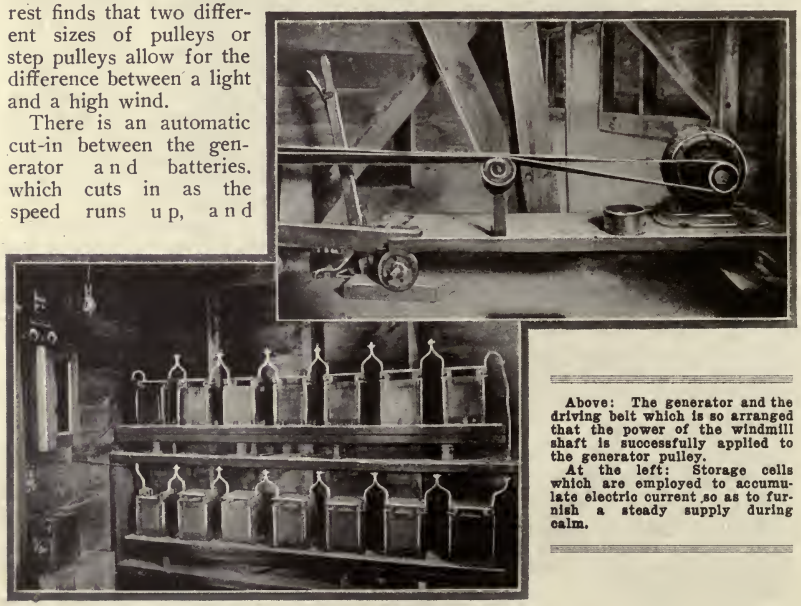
The feed grinder is of the combined foot gear type, and as the speed dies down the rings clear themselves, leaving them in a condition to start up

easily when the wind again rises. There is a clutch used to start and stop the grinder automatically, and above this is a spring which, in case a nail or piece of iron gets into the grain, disconnects the grinder so that nothing will break. An elevator carries the grain into a large hopper above the grinder, and this also is started and stopped automatically. Below the grinder is room for the ground feed. The windmill works away sometimes grinding at the rate of three bags per hour.

The dynamo or generator is marked 35 volts, 6 amperes, .21 kilowatts and 450 revolutions per minute. It is run with a horizontal pulley on the upright shafting and is operated with a clutch; the belt making a quarter turn over an idle pulley, thus doing away with bevel gears. A two-inch leather belt has to be reasonably tight to prevent it from slipping, as it seems to buckle in as the speed increases. The windmill sometimes runs as high as 600 revolutions per minute. To meet these conditions Mr. Forrest finds that two different sizes of pulleys or step pulleys allow for the difference between a light and a high wind.

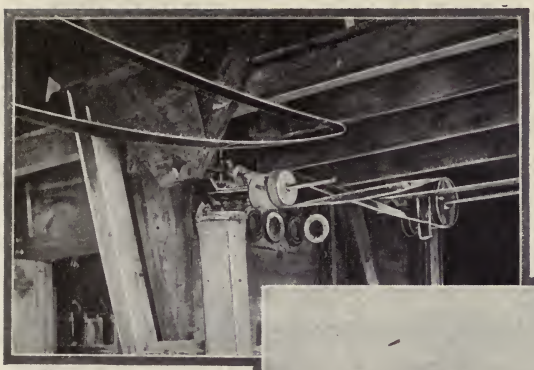
There is an automatic cut-in between the generator and batteries, which cuts in as the speed runs up, and drops out as the speed decreases, thus preventing the electricity from flowing back into the generator and being wasted. This cut-in, which is kept in a cabinet under lock and key, forms a very important part in a windmill driven plant and works equally well with a gasoline engine drive. There are two meters, one a volt meter and the other an ammeter, which register the rate of charge and discharge, as well as indicate if there are any lights turned on and about how many.

The storage battery comprises fourteen cells, each having three positive and four negative plates. Each cell gives about two volts; the entire battery furnishing current suitable for 25-volt lamps, with a capacity of 120 hours for each lamp. The cells are arranged in two rows, seven in each row. The glass jars or cells are set on sand in wooden trays and these trays are placed on shelves. The electrolyte in the cells will not freeze in a temperature 30 degrees below zero. The cells are very simple to set up and to fill



Above: The generator and the driving belt which is so arranged that the power of the windmill shaft is successfully applied to the generator pulley.

At the left: Storage cells which are employed to accumulate electric current so as to furnish a steady supply during calm.



To the left: Interior of the windmill building showing arrangement of bevel gears at the base of the windmill shaft. By means of these gears the power is transmitted to a horizontal shaft.

At the right: The buildings in which the windmill electric plant is located. The peculiar construction of the windmill tower will be noted in the picture; the framework being entirely closed in.

with electrolyte, which is diluted sulphuric acid and requires only the addition of a little distilled water to replace that which evaporates. About ten gallons of distilled water a year are used.

After purchasing three two-gallon jugs of distilled water at a drug store at 20 cents a gallon for the water and 25 cents apiece for the jugs, Mr. Forrest hit upon a novel scheme for cutting out this expense. Taking a copper kettle, he soldered a copper tube in the cover, corked up the spout, fitted a one-half inch lead pipe over the tube, and bent it so as to connect in the mouth of a jug which is set on one side of the kitchen stove or range. The kettle was then placed on the stove and filled with water, and, while the stove was being used for cooking purposes only, there was collected in a few days enough distilled water to last several months. Aside from the lubricating oil for the windmill and generator, the expense of running is practically nothing.

After two years' use Mr. Forrest finds his battery in as good condition as when he bought the cells. And the outfit is not only very durable but perfectly safe to handle. The low voltage used, which is less than one-fourth the pressure usually carried in cities, eliminates all danger from fire.

With the current costing practically nothing after the equipment is installed, Mr. Forrest's plan is to use it lavishly while the wind blows and save it during the calm. His plant cost about $250; he never studied electricity but says he merely followed directions and has no trouble at all.

According to the North Dakota Agricultural College, which has issued a bulletin on this subject, the use of a windmill for electric lighting and power purposes is possible in almost any part of the United States. A well-designed equipment, together with a 14- or 16-foot windmill, will generate enough electricity to charge a storage battery. By this means current can be

used to do the pumping, washing, churning, to separate the milk, and to light a house of sufficient size to accommodate fifteen persons, as well as illuminate all stables and outbuildings necessary for a farm of 1,200 acres or more. With a storage battery it is possible to accumulate a supply of electricity sufficient to extend over periods of atmospheric quiet of from two to ten days' duration, depending upon the size of the storage battery. During periods when the wind blows continuously, as it frequently does in the Central States, electricity can be used for ironing, cooking, and many other purposes too numerous to mention.

THE SCALE REPLACES COUNTING MACHINE

A weighing machine for the counting of street car tickets now replaces even the rapid counting machines which hitherto have outrun the most nimble fingers. According to its inventor, Walter S. Smith, Columbus, O., a scale engineer, the weighing device excels the machine counter to an extent proportionately even greater than the latter outdid the old-fashioned finger and thumb.

A very accurate balance, capable of weighing a fraction of a pinhead, now used for counting tickets.

The new ticket weighing machine is simply a very finely adjusted scale. It will weigh a fraction of a pinhead. It will actually weigh one-fourth of a car ticket. Its principal parts are: a receptacle for the tickets, a scale beam, and a dial and indicator at the top. The indicator does the particularly delicate weighing after the general weight of the tickets is indicated on the beam. One-half of a ticket will cause the indicator to sway perceptibly. The face of the dial shows the number of tickets according to their weight.

The new device is being used now by the Columbus Railway & Light Company. It can weigh and count as many as 15,000 tickets at a time, and since each ticket weighs three grains, more than six pounds of tickets can be counted in a twinkling. The company collects about 300,000 a day. Formerly, seven clerks were employed to operate seven counting machines to do the daily counting. The task then consumed five hours. In marked contrast, the weighing machine, according to its inventor, does the work in almost as many minutes.

ELECTRIC STERILIZING

It is reported from Holland that there has been invented there an apparatus that sterilizes milk by electric light. It contains a mercury-vapor lamp, so arranged that a thin stream of milk may be made to flow over the surface of it. The ultra-violet rays from the light quickly destroy all bacteria in the milk. Demonstrations were first made with water containing various kinds of bacteria. The water was purified in a few minutes with but slight increase of temperature.

Telephoning from New York to San Francisco

By Austin C. Lescarboura

TO everyone connected with the telephone business in this country these words mean much: "Mr. Watson, please come here, I want you." This sentence has been made famous on two occasions: the first, when Dr. Bell, the inventor of the telephone, caused his voice to travel over some ten feet of wire and be heard by his associate, Mr. Watson, thereby proving that the telephone was a possibility; and again when Dr. Bell spoke the identical words to Mr. Watson over a line of 3,400 miles between New York and San Francisco.

On January 25th at 4 o'clock about two hundred guests of the American Telephone and Telegraph Company were gathered in a room of the telephone building in New York to participate in the formal opening of the first trans-continental line between New York and San Francisco. The honor of being the first person to formally talk over the line rightly fell to Dr. Alexander Graham Bell; the listener at the other end of the line being none other than his old-time associate, Mr. Thomas A. Watson.

"Hello, Mr. Watson, are you there?" asked Dr. Bell. His face broke out into a smile of unrestrained happiness when the voice of his associate came back over the long spans of copper. After Dr. Bell, other distinguished guests spoke over the telephone line, among them Mayor Mitchel of New York, who conversed with Mayor Rolph, Jr., of San Francisco.

Later, Dr. Bell requested as a matter of sentimental interest that a duplicate of his first telephone instrument be connected in the trans-continental circuit in place of the regular desk type of telephone which he had been using. Not only was his request complied with, but connections were made through a small coil of the wire which the inventor had used for telephoning his first complete message. Holding the rather cumbersome transmitter to his mouth, Dr. Bell shouted: "Mr. Watson, do you hear me now?" To his great amazement the reply was in the affirmative. He had been heard over 3,400 miles of wire, using one of his instruments of over forty years ago! No one was more surprised than the inventor. Regarding his crude instrument with a look of fondness and admiration, he remarked that the lines and the equipment of the present-day telephone system had reached a high state of perfection to permit of the successful use of such a crude instrument over so great a distance.

The telephone is the result of an accident. If something had not gone wrong with one of the telegraphic instruments with which Dr. Bell and Mr. Watson were experimenting, it might not exist to-day. Here, briefly, is the story:

It was during the year 1875 that Dr.

Bell, then a young man about twenty-seven years old, was conducting unceasing experiments with a system of harmonic telegraphy; his idea being that over a single telegraph line a number of messages could be sent simultaneously, using a number of transmitters sending as many currents of different periodicity and, at the receiving end, an equal number of harmonic receivers, each being affected only by the current from one of the transmitters. The harmonic receivers consisted of an electro-magnet over which was mounted a steel armature tuned to a certain musical pitch.

Dr. Bell would spend hours at a time adjusting the pitch of the receivers. He was engaged at his customary task on the afternoon of June 2, 1875, in the attic of Charles Williams' workshop at 109 Court Street, Boston. In one room were three transmitters of three different pitches, three receivers with springs tuned to the same pitches, three signaling keys and a galvanic battery. In the other room were duplicates of the receivers. All the instruments were connected to a short line running between both rooms. That afternoon Mr. Watson was in the room with the duplicate receivers.

While Dr. Bell was preparing to send some signals he was surprised to notice the vibrations of one of the receiver springs, although none of the keys had been pressed. This struck him as being remarkable and he pressed the receiver to his ear. To his great surprise he heard a faint twang that had the unmistakable timbre of one of the receiver springs. He heard the twang several times and then rushed into the room of his associate to find out what he had done.

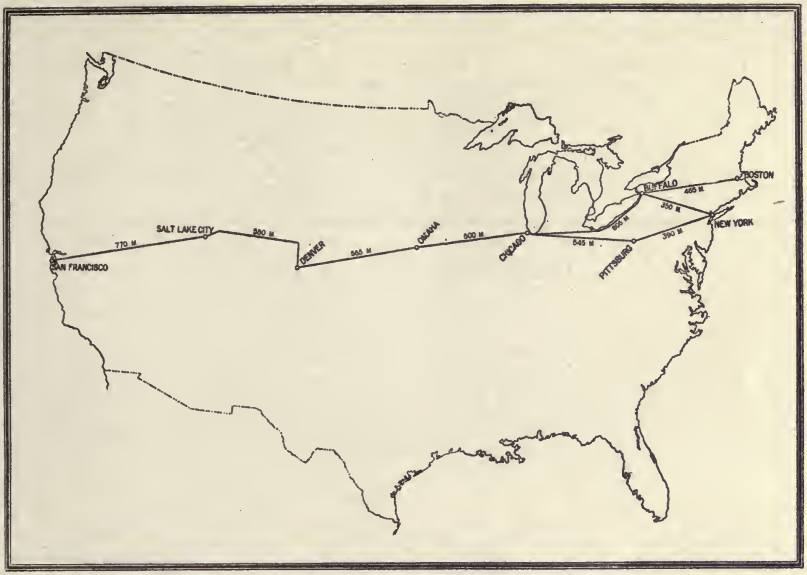
Watson in the meantime had been having troubles of his own. One of the receiver springs had become stuck and he was giving it some pretty vicious snaps when Dr. Bell rushed in excitedly. At a glance he noticed the source of the sound he had heard at the other end of the line. The sticking of the spring had answered a problem he had long thought of—a means of varying the strength of an electrical current flowing through a circuit in accordance with the fluctuations of sound waves. Dr. Bell knew that if the twang of the spring could be transmitted over the line, any other sound—even the fine modulations of the human voice—would be heard over the wire with the proper apparatus.

All afternoon Dr. Bell and Mr. Watson kept plucking springs and hearing the noise produced at the other end of the line. In the evening Dr. Bell gave his associate a sketch for the first speaking telephone. This consisted essentially of one of the harmonic receivers with a drum head attached to the free end of its spring.

The next day the instrument was ready for a test and it soon proved that Dr. Bell's theory was correct. A line was strung between the attic and the third floor of the building, since the adjoining rooms were so close together that the shouting of Dr. Bell could be heard by Watson without any apparatus. Sounds were transmitted over the line that day, although they were indistinct and the words could not be made out.

After this test followed many similar ones, interposed with many changes in the designs of the telephone apparatus. It was not until the following March, however, that the first message was received over a line in its entirety. In the meantime to avoid undesirable publicity Dr. Bell moved his apparatus to a boarding house at No. 5 Exeter Place, Boston, in which two rooms were used on the top floor for conducting the experiments. It was during the course of an evening when Mr. Watson was aiding Dr. Bell in some experiments that he heard the famous sentence issue from the receiver, "Mr. Watson, please come here, I want you." This was the first entire sentence ever transmitted by telephone—the first logical proof of the practicability of this means of communication.

To mention even briefly the various steps in the development of the telephone from that point to the present time is impossible in so limited a space. But it is well to bear in mind that a short time later Dr. Bell placed his



Route of the Trans-Continental Telephone Line from New York to San Francisco. A sound requires 1/15 Second to Travel over this Line of Approximately 3,400 Miles.

still crude invention in the hands of John J. Carty, now chief engineer of the American Telephone and Telegraph Company, who, with the aid of his vast engineering staff and that of numerous inventors, brought the telephone to its present state of development. To-day, the telephone has 130 parts, the transmitter is the 73rd type devised and the receiver the 53rd since the year 1876.

But let us return to the latest and most wonderful telephone achievement, the trans-continental telephone line.

The loading coil, the invention of Professor Pupin of Columbia University, has had an important role in the development of long distance telephony. As in the instance of other telephone equipment, this idea was taken over from the inventor and continually experimented with and improved upon by the engineers of the company. To-day, the loading coil usually measures about four or five inches in diameter as compared to the earlier types which were as big as nail kegs. The iron wire used in the loading coils must be as fine as a hair and perfectly insulated.

In the line between New York and San Francisco there are 3,400 miles of hard drawn No. 8 B. W. G. copper wire. There are four such wires from which are derived two physical circuits and one phantom circuit. The diameter of each wire is .165 inch. The weight of the wire is 870 pounds per circuit mile, that is to say, 435 pounds per mile for each wire, two wires being required for each circuit. The total weight of one circuit of two wires is 2,960,000 pounds or 1,480 tons. In the line itself there are 130,000 poles. As for the wire in the loading coils, it is of interest to note that in addition to the 6,800 miles of hard drawn copper forming each circuit there are 13,600 miles of fine iron wire in the loading coils. The voice travels over the 3,400 miles of line in 1/15th second, or at a rate of 56,000 miles per second.

THE average man is of the opinion that an invention requires a long and untiring period of research on the part of its inventor until he discovers his original idea. This, however, is in direct opposition to the actual facts in most great discoveries. It is often the merest incident that will suggest a revolutionizing invention. Other times it is an accident, great or small, or again it may be due to circumstances.

Inventing by Accident

By H. J. Grey

THE essential principle of the talking-machine was discovered by Thomas A. Edison as the result of an accident while experimenting with a telephone. A needle had been fixed to

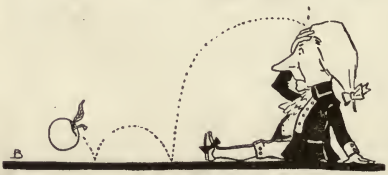
the vibrating disc of thin metal that produced the sound, and as a result of the vibration the needle was driven into the experimenter's hand. The incident set the famous inventor thinking, and a new series of experiments were devised. A roll of paper was made to rotate slowly with the needle pressing lightly upon it, while the inventer shouted "Hello" into the telephone. On reversing the paper and starting it again, it answered a very faint and distant "Hello." Since that day enormous improvements have been made, but the actual principle remains the same.

Everybody knows how Sir Isaac Newton was led to discover the force of gravity by considering the fall of an apple from a tree. History does not record, however, whether the apple hit Sir Isaac on the head or fell at this feet.

The incandescent gas mantle that is still used in so many thousands of homes, despite the more recent electric light, was also discovered accidentally.

Thirty years ago, Dr. Carl von Welsbach was conducting some researches in the color of flames containing the vapors of metals and chemical substances. Without any idea of revolutionizing the lighting of streets and houses, but merely to get a better flame for his purpose, he soaked a piece of cambric in a chemical solution and supported it over a flame of mixed gas and air. The cambric burned away and a sort of delicate skeleton of ash was left which glowed with a brilliant light. This was the first incandescent mantle, and now hundreds of thousands are sold every year.

In a sense, the homely safety pin, of which millions are in use to-day, was the result of chance. The inventor was



a poor man, tramping through the country with his wife and baby in search of work. The child suffered much pain from the long pins with which its clothes were fastened, and the father thought he could substitute a piece of wire that would answer the purpose as well and be much safer. And so, after one or two attempts, he bent a few inches of wire into the first safety pin that was ever made.

Wireless telegraphy is another example. Probably most people know that wireless messages are sent by means of waves of electricity that travel through space, though they may not know just how it is accomplished. Before this could be done it was necessary to know something about these electric waves. They were discovered by a German scientist through an unexpected happening in his laboratory. He had two pieces of electrical apparatus, known as Leyden jars, which were charged with electricity. One was intentionally discharged, and immediately the other one across the room discharged itself with a sharp crack and a brilliant spark.

This set the scientist thinking, and he concluded that there must have been some kind of wave, similar to light or sound, yet invisible and inaudible, passing from one jar to the other. Of course, it is a big step from this simple experiment to a present-day wireless installation on board a huge ocean greyhound, but it was the very first and necessary step in the discovery of wireless telegraphy.

Gunpowder, though known to the Chinese for centuries, was not imported into this country from the East. It was discovered by the philosopher Bacon in the course of searching for the so-called philosopher's stone.

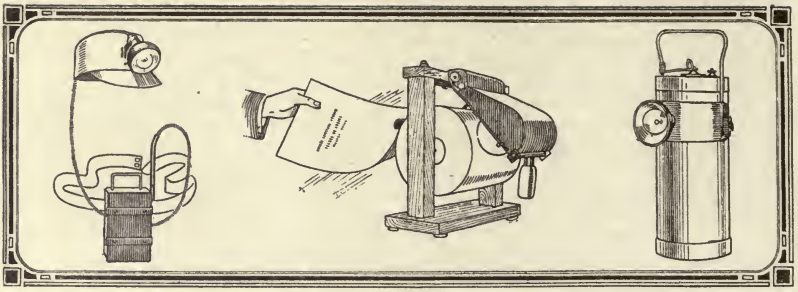
Thinking that this mythical substance, upon which the alchemists placed so high a value, might be made from nitre, brimstone and charcoal, a mixture of these materials was made and placed in a crucible over a fire. Of course it promptly exploded, and from this accident came gunpowder.

Radium has certainly aroused great interest since its discovery. It was a good many years in being discovered, but a lucky accident paved the way. Professor Becquerel allowed some crystals of a substance containing the metal uranium to remain for some time on a photographic plate. The plate was protected by the usual black paper envelope and no light could have reached it, yet on being developed it was found to have taken an impression of the crystals.

Obviously, some invisible agency was at work capable of penetrating the black paper, and after much patient labor it was found that not only the salts of uranium which photographers use but several other substances were capable of producing a similar effect. Pitchblende was one of them, a mineral containing not only uranium but the immensely valuable metal radium

as well. Monsieur and Madame Curie, the distinguished French chemists, discovered that the waste material from pitchblende, after the uranium had been extracted, had a still more powerful effect upon the sensitive plate. They finally succeeded in obtaining a small fraction of a grain of radium from a ton or more of pitchblende waste. But that fraction of a grain was worth infinitely more than its weight in gold, and led to some of the most surprising discoveries of modern science.

There are perhaps innumerable other instances in which a mere accident resulted in a great invention. In fact, most great inventions are direct or indirect results of accidents or circumstances, although in fairness to their inventors it is but right to remember that there often exists a great gap between the fundamental discovery and its successful commercial application—a gap that stands for months or even years of untiring experimenting with, and the improving of, the original idea.



Miner's Electric Lamp. Printer for Wrapping Paper. Lamp Attachment for Dry Cell.

Recent and Improved Devices

Miner's Electric Lamp

With the dangers of fire damp explosions in mines brought to our notice by the many fatal accidents in recent years, it is not strange that at least one concern has specialized in the production of miners' safety lamps. One of the latest and most successful products in this field is shown in the accompanying illustration.

Not only is this lamp absolutely safe in an explosive atmosphere, but it is thoroughly dependable as well. In a recent test, the lamp and battery were placed under water and under these adverse conditions the lamp was burned continuously for twelve hours. At the end of this period no harmful effects could be observed as a result of the immersion. From this it is safe to conclude that the outfit could be used with entire satisfaction in the wet shafts of mines.

Printer for Wrapping Paper

The proprietors of small mercantile establishments will undoubtedly be interested in an automatic printing attachment which may be used in connection with the ordinary rolls of wrapping paper to print an advertisement as the paper is taken from the roll.

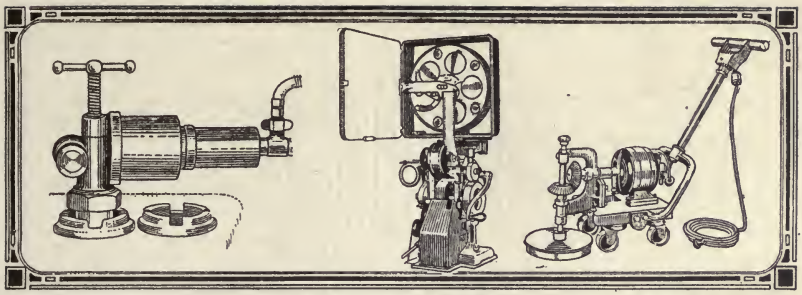
A wooden roller, having the necessary type mounted upon its face, is fastened by means of a thumbscrew on the frame of the paper roller. It is so arranged that when the paper is pulled from the roll the type roller passes over its surface, leaving the desired impression.

Lamp Attachment for Dry Cell

Still another of the various attachments for dry cells, converting the cell into an electric hand lamp or lantern, is seen illustrated herewith. The attachment comprises a handle of wire fitted into a clip of sheet metal that springs around the dry cell and which carries a reflector containing a small lamp bulb. The device is exceedingly low in price and seems to fill a long-felt want, creating a new field for the standard size of dry cell and placing a practical hand lamp within the reach of everyone.

Auto Tire Pump

A tire pump which presents many features of interest may be seen illustrated on opposite page. The pump is designed to be fastened into the cap over one of the exhaust valves of the engine, and not the least interesting point in connection with the device is the ease with which it can be set up and re-



Auto Tire Pump. Non-Rewinding Film Reel. Floor Finishing Machine.

moved. The operation of the pump piston is brought about by the compression in the engine cylinder, the expanding gases forcing the piston to the end of its cylinder at every stroke of the engine. The entire absence of mechanism likely to get out of order makes the device a valuable one for the rough and ready conditions of the road.

Non-Rewinding Film Reel.

Motion picture films, after having been run through the projecting machine, must be rewound before they can be used for the next performance. This extra handling has always been a source of annoyance and expense, to say nothing of the fire hazard involved.

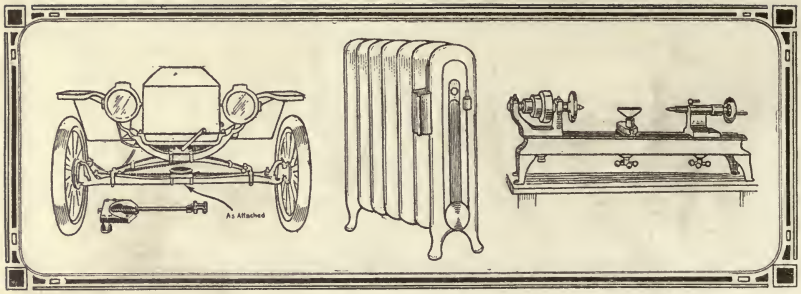
In the illustration is shown the appearance of a new device designed to make this rewinding quite unnecessary. In the design of a machine for this purpose, two problems had to be solved; the nature of the film makes it unwise to carry the band of celluloid, with its delicate emulsion face, over a sharp turn and, owing to the fact that, in a device of this nature, the film must be brought out from the center of the reel instead of from the outside, the film must be unwound by some force other than that of its own pull, since the force applied at the center of the reel has but little power to turn it.

The first condition is met by a series of arms and guides that effectually prevent the film from kinking. The second is taken care of in a most ingenious manner. The outside face of the reel is stationary, while the inside face and the spool around which the film is rolled are removable and are geared to a small electric motor through a magnetic clutch. The film passes out of the reel over a movable roller which is connected with a small switch. When the film becomes taut, the switch closes, the magnetic clutch is energized, and the reel revolved by the motor, thus loosening the film. When the film becomes sufficiently loose, the switch opens and the reel stops revolving. Thus the film is fed out at precisely the correct rate of speed.

Floor Finishing Machine

With the widespread introduction of hardwood floors, many machines for automatically surfacing the wood have been offered to workmen specializing in this line. One of the most substantial of these machines is seen illustrated on this page.

The device consists of a truck body carrying a motor and transmission mechanism which imparts motion to a grinding and polishing head fitted to a vertical shaft. Instead of the back-breaking task of going over a newly laid floor with plane and sandpaper, the present-day workman uses the new machine as one would use the lawn mower, but with far less exertion.



Safety Steering Device. Humidifier for the Air. Bench Speed Lathe.

Safety Steering Device

The driver of a light car not equipped with a worm steering gear knows what a problem it is to keep the car in its path when passing over sandy or muddy roads, or when one of the front wheels strikes a rut or chuck hole. The nervous tension is great and at times driving ceases to be a pleasure.

A device designed to prevent this strain is illustrated above. The device is readily added to the steering gear of any light car and, once in place, it is said to eliminate the vibration of the steering wheel when traveling on rough roads, preventing skidding in crossing tracks and in going through sand or mud, and relieving the driver of the feeling that he must keep a forced grip on the wheel. The price of the device is so low and it is so easily attached that there should be a ready field for it.

Humidifier for the Air

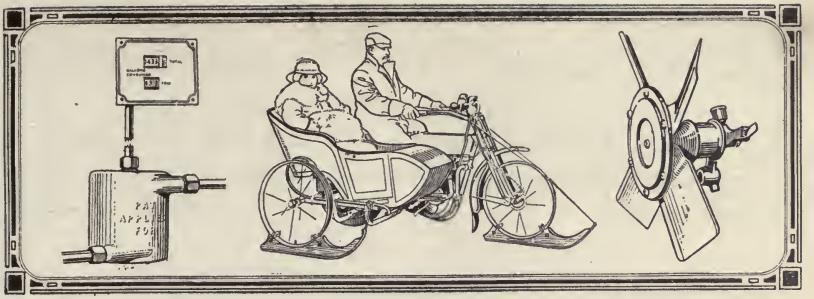
Steam heat, while ideal from many practical points of view, has its drawbacks, and not the least of these is the property of drying out the air in a room to the point where the mucous membrane of the throat begins to suffer. Many suggestions have been offered for effecting the proper supply of moisture to steam-heated air and, while all or nearly all may have some value, still it is probable that none can compare with the specially designed device shown in the illustration.

The humidifier is made of a certain kind of clay, treated by a special process which gives it the porous quality essential to its successful application in this connection. The device is hung on the steam radiator and filled with water. The porous walls of the container soon become saturated with water and liberate the moisture constantly and in just the proper quantity when the heat is turned on.

Bench Speed Lathe

The crowning ambition of the average amateur mechanic or experimenter is to own a lathe—perhaps nothing more than a polishing head with an improvised tailstock, but still a lathe. From the announcement of a New York manufacturer, it may be assumed that the home craftsman is at last to be supplied with a thoroughly practical machine at a low price. What is more, the lathe is said to be substantially built and sufficiently accurate for all ordinary work.

The lathe is made in two sizes, having an 8-inch swing and distances of 8 and 20 inches, respectively, between centers. The lathe has practically all of the qualifications of the best types of modern speed lathes. The spindle is hollow and the opening through the center is ½-inch. A full complement of chucks, arbors, saw tables, etc., can be obtained and for metal turning, a slide rest of simple but effective design is furnished.



Liquid Fuel Meter. Motorcycle Sleigh. Mechanical Auto Horn.

The lathe should find a ready field among manual training schools, shops, tool rooms, home workshops, etc.

Liquid Fuel Meter

The advent of the present-day gasoline engine, through its cheapness, simplicity and all around utility, has proven such a boon to the user of portable motive power that the mere question of its operating cost, from the standpoint of accurate measurements, has all but been overlooked. The average user of a car or motor boat knows roughly how many miles he can travel on a gallon of gasoline, but here the matter rests.

In the illustration is shown a meter designed especially for use in connection with gasoline and other engines using liquid fuel. The meter works on the principle of a water meter and in operation it is exceedingly simple. The mechanism is so designed that the meter will register correctly the consumption of fuel regardless of the rate of flow or any variation of pressure.

The illustration shows a meter of the automobile type; the case containing the mechanism is placed under the floor of the car while the dial plate is secured to the dashboard where it is clearly visible at all times.

The meter registers the consumption per trip, per day or per week, etc., accordingly as the driver desires. It also furnishes a ready means of comparison between the efficiencies of different engines working under similar conditions.

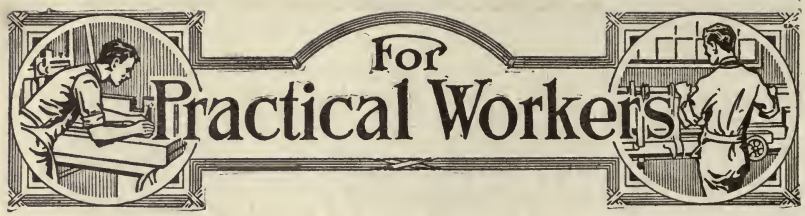
Motorcycle Sleigh

When there is a light fall of snow on the ground, a motorcycle may be operated over good roads without great difficulty, but when the flakes come down thick and fast and continue to do so for days at a time, the average motorcyclist feels that it is time to put his machine away for the winter. An ingenious resident of Galt in snowy Canada has apparently solved the problem, however, by adding runners to his machine as shown in the illustration.

The rubber tires were taken off the front wheel of the machine and off the wheel of the side car, and runners bolted on the rims in place of the tires. The tire remains on the rear wheel of the machine for driving purposes, the runner on the front wheel making a rut in which the driving wheel can find a grip. It is claimed that the machine has traveled through a foot of snow without the slightest difficulty.

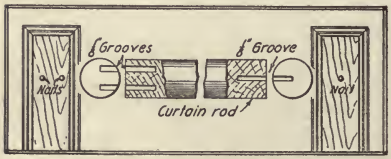
Mechanical Auto Horn

An auto horn, mechanically and not electrically operated but producing the sustained note of an electric horn, has recently made its appearance on the market. The novel feature of the horn is that it forms a part of the cooling fan on the engine. On the front of the fan is secured a diaphragm in a suitable casing, and the pressure of a button actuating a cable serves to bring the diaphragm into contact with a mechanism that sets up the vibration necessary to produce the sound.



Curtain Rod Support

A curtain rod supported in the manner shown in the illustration may be lifted off at a moment's notice when it is desired to take the curtains down. The rod is supported by three nails which fit into



grooves cut into the end grain, as shown. The rod is prepared by cutting it to a length that will make it a snug fit between the door jambs. The slots are then cut, two being placed in one end and one in the other end of the rod. Headless nails are driven in the door jamb on either side to take the slots and the support is finished.

Contributed by

AUGUST J. LOCKER.

Ground Glass Drawing Boards

A sketching board for use by the student or in the drafting room in laying out sketches, details and illustrating on a large scale, is a much desired convenience. Similar in use to the old-fashioned slate, the ground glass drawing board, painted black on one side, serves this purpose admirably.

In making the sketching board, a fine, evenly ground surface should be used to work on and the reverse side of the glass should be given two or three coats of smooth, black paint. The edges of the glass board should be squared to permit the use of the T square and triangles. Small slate pencils are the best for sketching and should be kept sharp by means of the ordinary sandpaper pad. Erasing is easily accomplished by the use of a damp sponge or cloth, thus eliminating the dust and dirt incident to art gum or other erasers used dry.

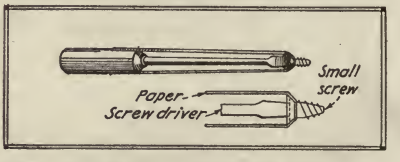
Boards up to two or three feet square need not be mounted, but for larger sizes they should be adequately supported in a flat position. The saving in paper for the student, for the school or for the drafting office is quite obvious.

Contributed by

FRANK H. JONES.

To Start a Small Screw

To start a small screw in an inaccessible place, cut a narrow strip of paper, pass the screw through the center of it and hold the screw against the blade of the driver by bringing the ends of the paper around, as shown in the illustra-



tion. After the screw is started, tear the paper away.

Contributed by

J. K. P., JR.

Cement for Handle-Bar Grips

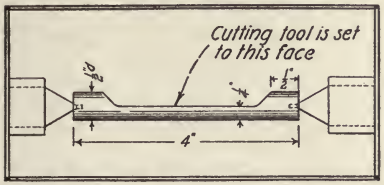
The writer has found that pure tar makes an excellent cement for fastening the grips on the handle bars of a bicycle.

Contributed by

F. GREY DALY.

Tool Centering Device

The little device shown in the illustration will enable one to quickly set the lathe tool on the dead center. The device is merely a piece of ½ inch diameter steel rod about four inches long, centered at



either end and milled down to exactly half its diameter as shown in the drawing. The rod is placed between lathe centers and the tool set to the height of the milled portion.

Contributed by

JAS. MCINTYRE.

Wire Straightener

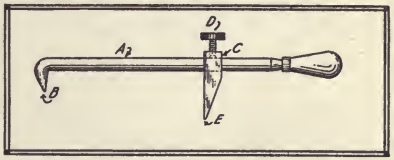
In the illustration may be seen a device for straightening wire that has been wound in a coil. The implement was made from an old turnbuckle casting having a boss on either end. In the sides of the boss, holes were drilled and tapped for the screws, *D*, which were fitted with check nuts, *C*. In the end of each screw was drilled a ⅛ inch hole, as shown in the sketch below at *E*. The turnbuckle was chucked in the lathe and the wire to be straightened passed through the spindle, on through the holes in the screws and held taut with a clamp at *A*. The screws were then drawn up tight against the wire and locked with the check nuts. The lathe was speeded up and the wire drawn out as straight as an arrow.

Contributed by

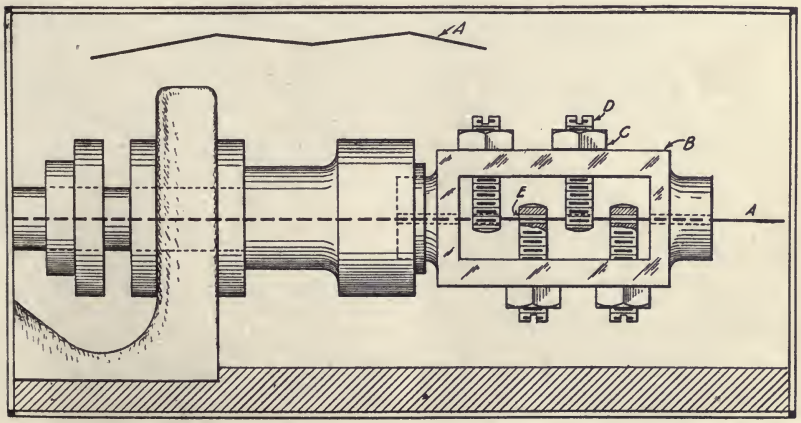
JAS. MCINTYRE.

Substantial Can Opener

A can opener capable of doing heavy service can be made in the average home workshop. The illustration shows the construction clearly. The rod *A* is of ¼ inch steel, four inches long and bent as shown at *B*. The end is sharpened to a point. The cutter *C* is of



steel ¼ inch thick, ⅜ inch wide and one inch long, sharpened to a cutting edge at *E*. A hole is drilled to pass the ¼ inch rod and in the top of the cutter another hole is drilled and tapped for the set screw *D*. A handle fitted to



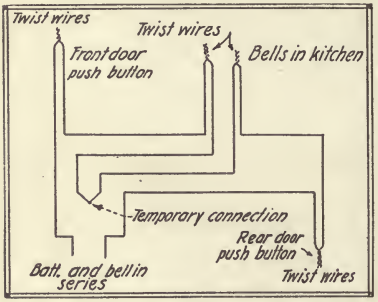
the end of the rod completes the can opener. In use, the pointed end of the rod is inserted through the top of the can, while the cutter, which has been set to the desired radius, is carried around with some pressure on the handle.

Contributed by

A. H. WAYCHOFF.

Test for Bell Circuit

In the accompanying diagram is shown a simple test for a bell circuit. At the point where the battery is to be located,



assuming that the installation is a new one, the battery and a bell are to be connected in series. Then, successively, at each point in the circuit where a push button is to be installed, the ends of the wires are to be twisted together. When the last connection is made, the bell should ring, but if it does not, it is an indication that there is a broken wire at some point in the line. In the event that the bell rings before the last connection is made, it signifies that a pair of wires is short-circuited, making it necessary to test out separately.

Contributed by

J. A. RODRIGUEZ.

A Durable Hickey

It often happens that the wireman on the job has nothing else but conduit pipe out of which to construct a pipe bender, or, to call it by its usual name, a hickey.

The thickness of the conduit wall is much less than that of standard piping and is not heavy enough for this purpose. It usually breaks right at the T where, because of the threading, it is the weakest.

If, however, a wooden plug is driven into the end of the conduit, before the T is screwed on, it will be re-enforced and capable of bearing a greater strain. Care must be taken not to force open the seam.

A hickey made in this manner is really to be preferred to one made of standard piping, because it is lighter and not so awkward to handle and less of a burden to carry from job to job.

Contributed by

JOSEPH GREOGRICH.

To Prevent Corks from Sticking

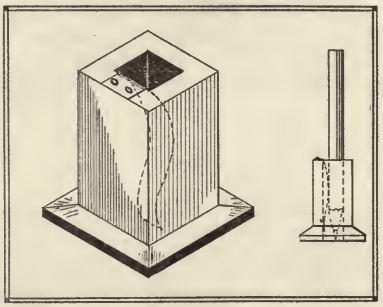
The cork in a glue or other bottle containing an adhesive may be prevented from sticking by dipping the cork in melted paraffin. The stopper is at the same time rendered more fully airtight.

Contributed by

B. W. VERNE.

Pencil Holder

A pencil holder for the workbench where pencils have a most annoying tendency to hide away, can be made from a spool with the end clipped off and a



piece of spring steel inserted as shown in the illustration. If the workman is more ambitious, he can make the holder out of a piece of square wooden stock, as shown in the larger drawing. The holder is to be nailed to the wall above the bench.

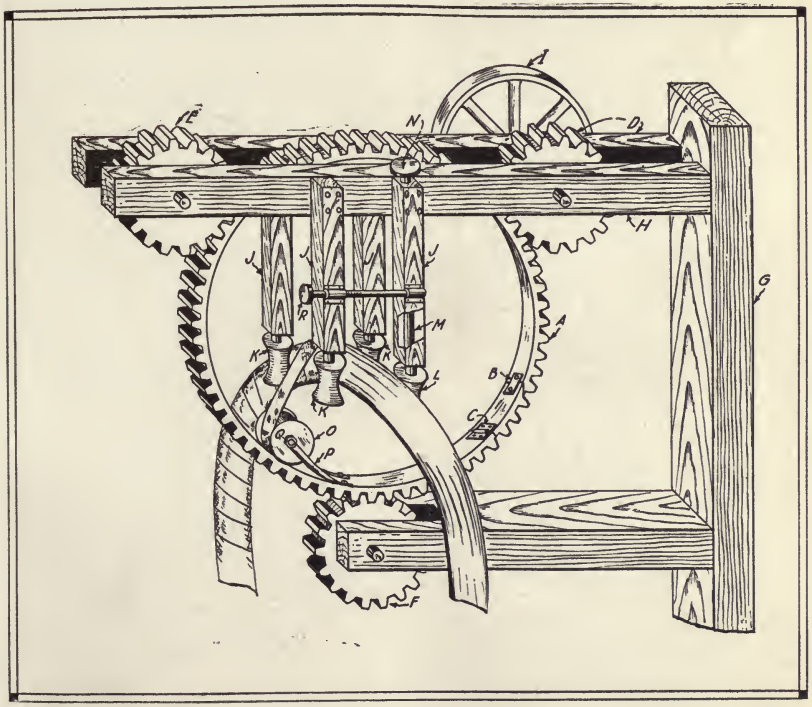
Contributed by

CLARENCE H. ANDERSON.

A WRAPPING MACHINE FOR AUTOMOBILE TIRES

By A. H. Waychoff

An easily constructed machine for wrapping automobile tires with cloth for retreading is shown in the accompanying illustration. An examination of the drawing will disclose the simplicity of the device which consists essentially of a large central gear, *A*, carried by three small gears, *D*, *E* and *F*, which are supported in a suitable framework of wood. On the inner rim of the large gear is fastened a spool carrying the cloth wrapper. The tire is supported between rollers, *K*, *K*, *K* and *L*, placed at the extremities of four wooden pieces, *J*. The roller, *L*, turns on a shaft, *M*, which passes through the wooden support, terminating in a friction pulley, *N*, resting against the edge of the large gear wheel. Obviously, when the pulley *I* is turned, the tire is fed between the rollers while the cloth wrapper is evenly and tightly wound as the gear completes its revolution.



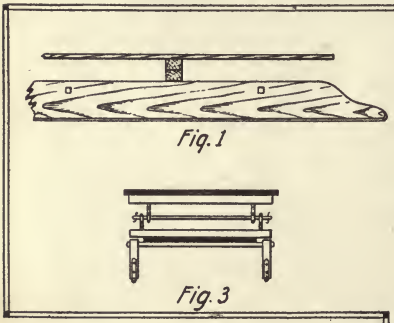
The illustration shows the construction so clearly that but few words of explanation are necessary. It may be well to call attention to the fact that the tire is inserted through an opening made by cutting a segment from the large gear, hinging the segment as shown at *CB*. The wooden pieces, *JJ*, may be brought closer together to grip the tire

by tightening the screw, *R*. To facilitate this adjustment the piece on the left hand side should preferably be supported on a pivot rather than by four nails.

A word on dimensions may be of assistance, although the parts may be of scrap material which will, of course, vary in size with different builders. The large wheel, *A*, should be at least 18 inches in diameter and it is prepared for the present use by cutting off all the spokes close to the rim. The small wheels, *D*, *E* and *F*, should be about six inches in diameter and, of course, of the same pitch as the large wheel in order that the teeth may mesh. The piece *G* of the frame is of 4 by 6 inch oak about 4 feet long. The bearing supports, *H*, are of proportionate size and are secured to *G* by means of substantial lag screws. The four rollers, *K*, *K*, *K*, *L*, are three inches in diameter and six inches long.

A Bob-Sleigh Suggestion

Bob-sleighs usually bought or made have the rear bob fastened to the plank, as shown in Fig. 1. This construction is unsatisfactory, for when the sleigh is passing over uneven ground, especially when heavily loaded, it has no rocking action and consequently great strain is occasioned where the sleigh is fastened to the plank. Very often the bobs are broken at this point because it cannot give enough.



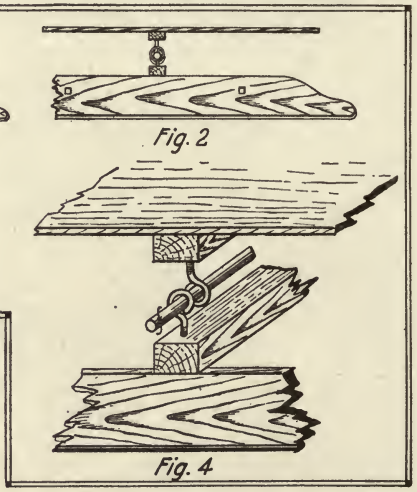
A much better way to connect the rear bob is to put large, strong screw-eyes into the upper and lower cross pieces, so that an iron rod can be passed through all the eyes, as shown in Fig. 3. This allows the rod to swing freely, as can be seen from Fig. 2, causing no strain. A ⅜ inch iron rod is strong enough, having holes drilled at the ends into which nails may be put to prevent the rod from slipping through the eyes, as indicated in Fig. 4.

Contributed by

E. C. Swetman.

Novel Air Pump

In exhausting vessels of air during the course of various experiments, it is customary to use either an air pump or an aspirator. The latter is composed of two tubes, one within the other. The outer tube is connected with the vessel to be exhausted, while through the inner tube a flow of water at comparatively high pressure is maintained. The vacuum caused by the rush of water past the tube draws the air from the vessel.



It is said that the tension of the water vapor prevents the formation of a very high vacuum with this pump. It occurred to the writer that a very high vacuum might be produced merely by using compressed air instead of water in

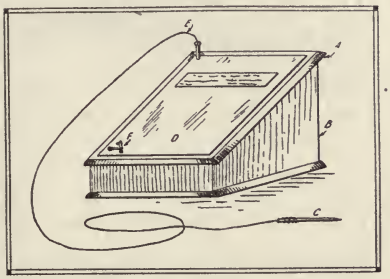
the aspirator and this theory has been borne out by a trial.

Contributed by

JAMES ASHER.

An Electric Check Writer

A device for writing the amounts in checks, drafts and other documents wherein it is essential that the amount



shall not be changed is shown in the accompanying illustration. The device consists merely of an insulated electrode, a ground plate mounted on a sort of desk, a small spark coil and a suitable battery. The secondary of the spark coil is connected to the electrode and the ground plate. In use the check is placed upon the ground plate, the spark coil started in operation and the electrode used as a pen in writing the amount on the check. The figures appear in a series of charred perforations where the spark has passed through the paper.

The spark coil and battery are placed in the desk and a switch in one corner gives the operator the necessary means of control. The electrode is made by passing a piece of stiff wire through the center of a hard rubber rod about ⅜ inch in diameter. The connection between the electrode and the secondary of the spark coil is made with a piece of high tension automobile cable in order that the user of the device may be protected from shock. The ground plate need only be large enough to cover the space required for the writing on the check and in this manner the operator is afforded an additional protection as it is necessary to touch both the bare point of the electrode and the ground plate at the same time before a shock will be felt. If care is taken to keep the hands at least ½ inch from the ground plate at all times, there is no danger of shock.

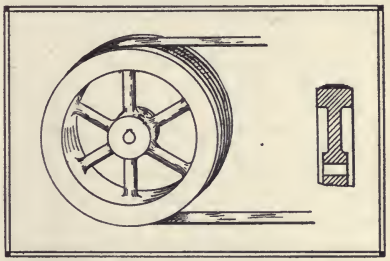
Contributed by

A. H. WAYCHOFF.

To Crown a Belt Pulley

Considerable difficulty was experienced by the writer when he attempted to belt a small dynamo to the fly wheel of the engine in a motor boat. The flat surface of the fly wheel caused the belt to fly off after two or three revolutions. After some experimenting the fly wheel was crowned in the following manner and thereafter no trouble was experienced:

Five thicknesses of ordinary electrician's tape were wound around the periphery of the fly wheel in a direction opposite to that in which the wheel turned, crowning the surface as shown in the illustration. The tape was then thor-

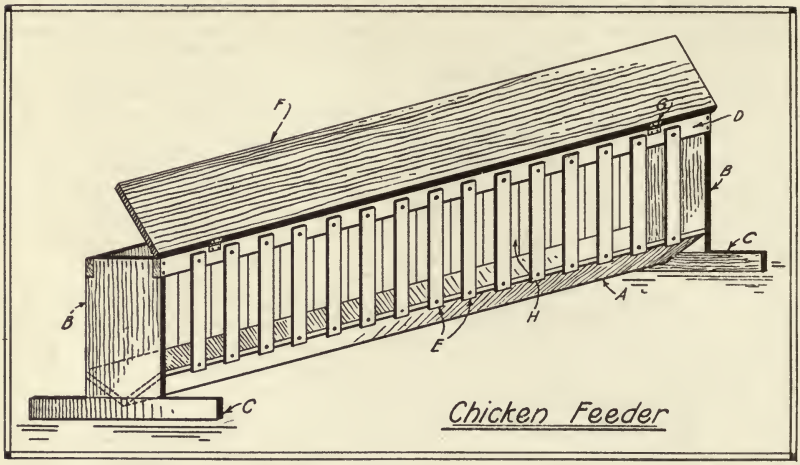


oughly shellacked and when the varnish had dried, the wheel was given a test which quickly proved the scheme to be practicable. At the end of the season the tape was found to be but slightly worn. During the entire run the belt did not once leave the fly wheel.

Contributed by

L. PHELPS.

¶ Have you an idea? Why not send it in to this department?



Chicken Feeder

Chicken Feeder

A chicken feeder that will reduce the waste of feed to a minimum is shown in the illustration. The feeder is easily constructed from the following material:

(*A*) 1 piece wood 4″ by 70″
(*A*) 1 piece wood 5″ by 70″
(*B*) 2 pieces wood 8″ by 15″
(*C*) 2 pieces wood 2″ by 20″
(*D*) 2 pieces wood 2″ by 72″
(*E*) 36 pieces lath ⅜″ by 1½″ by 12″.
(*F*) 1 piece wood ⅞″ by 9″ by 72″
(*G*) 1 pair strap hinges 2″ wide

The first step is to nail the two pieces *A A* together. The end boards, *B*, are then nailed to the trough, after which the feet, *C*, and the side rails, *D*, are placed in position. The addition of the slats, *E*, and the cover, *F*, completes the feeder.

The feed is placed in the trough and the chickens, although a bit strange at first, soon become accustomed to placing their heads between the slats to get the feed. The advantage of the feeder is that it keeps the grain off the ground where it is usually trampled and scratched into the earth, resulting in a large percentage of waste which is, of course, eliminated by the feeder.

Contributed by

P. P. Goerzen.

To Make Decalcomania Transfers

Designs may be prepared for the decalcomania transfer process by obtaining some gummed label paper from a printer and printing or lettering the design on the gummed side. The surface to which the design is to be transferred is coated with varnish and left to dry until "tacky" when touched by the finger. The transfer paper is then pressed down on the varnish and permitted to dry thoroughly, after which the back of the gummed paper is moistened with water, softening the gum and making it possible to pull the paper away, leaving the design firmly affixed to the varnish.

Contributed by A. H. Waychoff.

To Clean Mortar Off Board

A piece of wire netting, such as is used on screen doors, folded several times around a block and used as one would use sandpaper, will clean sand, mortar or other caked and gritty substances off the surface of a board that is to be planed or otherwise worked with an edge tool. The netting used in this fashion is far more efficacious than the coarsest sandpaper and it is less trying on the nerves than is a gritty piece of sandpaper rubbed over the mortar.

Contributed by Fred. W. Mueller.

A HIGH-POTENTIAL STORAGE BATTERY

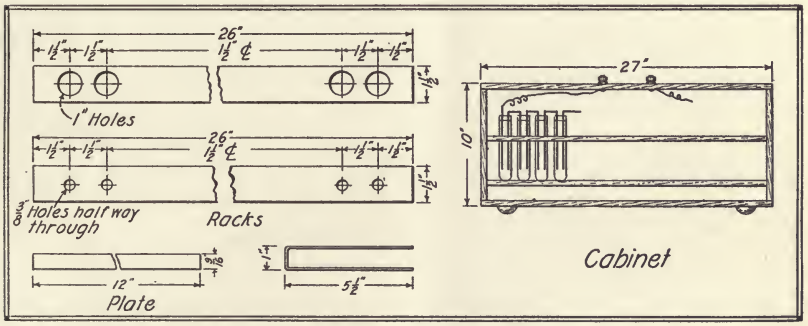
By Ray Francis Yates

Following is a description of a high-potential storage battery for laboratory use recently designed by the writer. This battery, when completed, presented rather a neat appearance and proved fairly efficient.

First, procure from a chemical supply house 48 test tubes measuring 1 inch across the mouth and 6 inches in length. From oak cut six pieces 26 by 1½ by ¼ inch. Three of the pieces are now marked and bored as shown in the sketch, each strip containing 16 holes. The remaining pieces are bored half way through with a ⅜ inch bit.

solution of sulphuric acid and water is used in the tubes, which may be filled within ½ inch from the top. The battery is charged in the ordinary way and should deliver a pressure of approximately 10 volts. The amperage is quite small after the initial charge, but increases as the battery becomes "seasoned" after repeated charging.

As a permanent fixture to the experimenter's laboratory, it can be arranged on a shelf and makes a very valuable addition. It can be made portable by arranging handles on the end and properly corking the tubes. A battery of this type



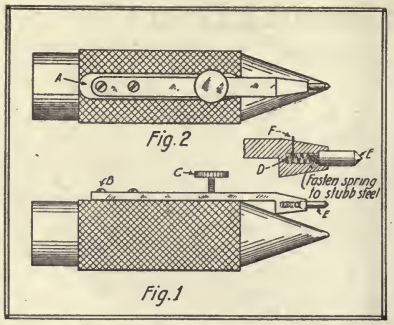
A containing cabinet is now constructed from ½ inch oak measuring overall 27 inches in length, 10 inches in height and 9½ inches in width. Brass screws should be used throughout the work to avoid the corrosive effect of the battery solution. The interior of the cabinet should be coated with lampblack or a similar acid resistant.

Cut from sheet lead 48 strips 9/16 by 12 inches and bend as shown in the drawing. The strips are placed in the tubes and the racks screwed into place. The outside of the cabinet is stained mission and two polished brass terminals mounted on the top with leads connected to them from one pole of the first and last tube. A fuse-block may be placed in the interior if desired. The usual battery can be constructed for any voltage desired by merely increasing or decreasing the number of tubes.

Spacing Center Punch

At times it is necessary to drill a number of holes a certain fixed distance apart and it is usual first to lay them out with a pair of dividers and then to mark the place for the drill with a prick punch. The spacing center punch shown in the illustration will save considerable time on a job of this kind, as it does both punching and laying out at one operation.

The simple addition of the spacing pointer to a punch of the ordinary variety makes the device. The punch hav-



ing been made or bought, is placed in the milling machine and a cut taken at *A*, Fig. 2. This forms a seat for the spacing arm *B*, which is filed up from a piece of Stubb steel. In the end of *B* is a hole to take the coiled spring which forms a cushion for the pointed plunger *E*. The spring is retained in the hole by means of the pin, *F*. The spacing arm, *B*, is to be hardened and then drawn to a spring temper after all the operations have been completed.

In use, the thumb screw *C* enables the operator to place the spacing point *E* at the required distance from the tip of the punch and when the latter is driven into the metal, the spacing point enters the hole against the pressure of the spring. After the first hole is spotted, the spacing point is placed in that hole ready for the next blow to be struck.

Contributed by

JAS. MCINTYRE.

Wing Set Screw

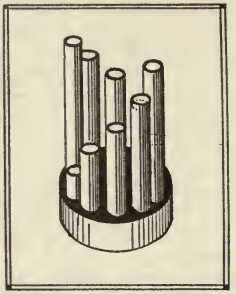
Wing set screws which may be used for a number of purposes such as replacing the lost set screw of a binding post, etc., may be made from the zinc terminal of a dry cell. The terminal is removed from the cell and a piece of brass, cut to the shape shown in the illustration, is inserted in the slot and soldered.

Contributed by

FRANCIS W. NUNENMACHER.

A Clarifier for Phonographs

This little device, if inserted in the horn of a phonograph, will make the sound much clearer, eliminating the disagreeable scratch to a large extent. To make the device, provide a disc of hard wood about two inches in diameter and ½ inch thick.



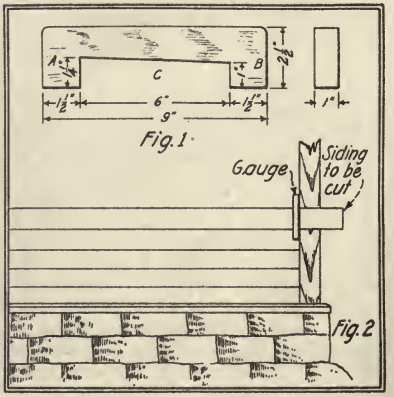
Place a rubber band around the disc and then drill a row of ⅜ inch holes around the edge as shown in the illustration. In each hole insert a piece of brass tubing, starting with a piece one inch long and making each succeeding piece ½ inch longer until five pieces are in place. Then start with another one inch piece in the opposite half of the disc and continue as before. When finished, the device is pushed down inside the horn, the rubber band on the edge of the disc holding it in place.

Contributed by

A. H. WAYCHOFF.

Marking Gauge for Siding

A marking gauge which insures an accurate fit in the corners when putting the



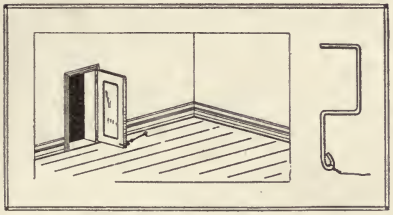
siding on a house, is readily made by the carpenter. A piece of wood is cut as shown in Fig. 1, which shows the utter simplicity of the device. In use, the parts marked *A* and *B* rest against the upright corner board of the house, allowing the piece of siding to be cut to pass through the open part *C*, as in Fig. 2. The piece is then marked with pencil or knife.

Contributed by

L. G. Burnand.

To Hold Door Open

To hold open a swinging door, it is suggested that a wire be bent in the shape shown in the illustration, fastened to a cord, and the latter secured to the floor. When the wire is slipped over the edge of the door it will not deface the woodwork, and when the door is closed



the wire will be quite inconspicuous on the floor.

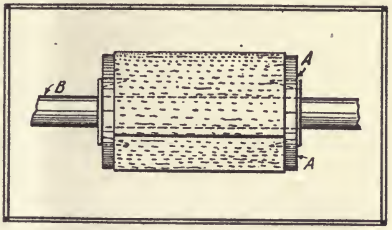
Contributed by

Frank Philippi.

Smoothing a Scored Cylinder

The scored cylinders of motorcycle engines can be made smooth by means of a properly constructed emery mandrel in the hands of a careful workman. The mandrel shown in the illustration is quickly and easily made, and in use it will be found quite satisfactory.

The mandrel is made by turning up a cylinder of wood somewhat smaller in diameter than the bore of the engine cylinder. The cylinder of wood is made in halves which are held together on the arbor by pinch dogs. Over each half of the cylinder is placed a sheet of fine emery cloth, the edges being glued down inside the joint between the halves of the cylinder. The mandrel is mounted in the lathe and revolved at high speed with the engine cylinder slipped over it and kept in motion constantly with the hands to prevent flat places from forming. The



mandrel should be kept liberally supplied with oil to prevent the emery from scratching.

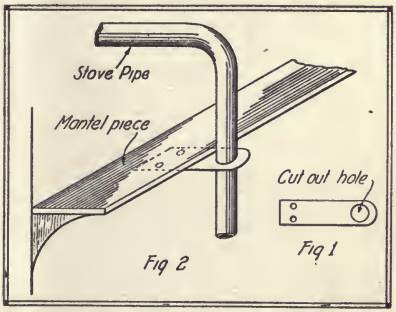
When the cylinder has been smoothed sufficiently, the oil and emery should be thoroughly cleaned out with gasoline before the cylinder is replaced on the engine. When the emery has worn off the cloth, it is only necessary to add a sprinkling of emery powder with oil as the cloth need not be renewed until it has become abraded.

Contributed by

Clarence H. Anderson.

Stove Pipe Holder

A suggestion for holding stove pipes is given herewith. The aim is to dispense with the usual wire and to put in



its place a holder that is neater and stronger. The holder is merely a piece of stove pipe iron cut to the shape indicated in Fig. 1 and having the holes as

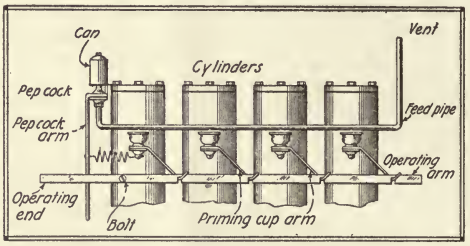
shown in the drawing. Fig. 2 shows the method of fastening the holder to a mantelpiece; obviously, by bending over the end containing the nail holes, the support may be fastened directly to the wall.

Contributed by

H. Drobe.

Automatically Priming a Marine Engine

A great deal of time may be saved in priming a marine engine of three or more cylinders by attaching the simple priming device here described and illustrated.



To begin with, an arm made of brass rod is soldered to the handle of each priming cup, and is bent at right angles one inch from the end. An operating lever is made of a strip of brass one inch wide and long enough to extend about six inches beyond the end of the engine from which it is to be operated. Four notches are cut in this lever to a depth of ¾ inch and are made wide enough to easily slip over the ends of the arms. A piece of small copper tubing extending the length of the engine directly over the priming cups forms the feed pipe for the priming fluid. The end is bent at right angles and extends upwards to form a vent. A small can with a screw cap is fastened to the operating end of the engine with wire, and into the bottom of this is soldered a petcock into which is soldered one end of the copper tubing. A V-shaped notch is filed in the under side of the tubing directly above each cup. Another arm is bent as shown and soldered to the handle of the petcock. With all the priming cups open, the place where the petcock arm crosses the operating arm is marked, and a bolt is inserted in the lever at that place. The petcock arm is then connected with the priming cup on the first cylinder by a spring, and is kept in position by an extension of the arm which comes in contact with the bottom of the can, as shown. As the lever is pulled back, the cups are opened, thus relieving any compression left in the cylinders; when the lever is pulled back as far as it can go, the arms are reversed and the cups are closed. During this second step the bolt in the lever comes in contact with the petcock arm, thus opening the valve and causing the primer to flow into the feed pipe and into the cups. When the cups are full the lever is pushed forward, the spring causes the petcock arm to resume its normal position and the gasoline is cut off. The primer runs into the cylinders through the re-opened cups after which they are closed. Any one of the cups may be opened in the usual way as each arm will independently slip out of its notch, or all the cups may be opened with the lever without causing the gasoline to flow into the feed pipe.

Contributed by

H. H. Raymond.

Bending Brass Tubing

To bend brass or copper tubing without kinking or buckling the walls, fill the pipe with melted rosin and allow to cool before making the bend. When the latter operation has been completed, the rosin may be melted out by heating the tubing slightly over a Bunsen flame.

Contributed by

Jack Poppele, Jr.

Handy Tap Wrench

When tapping a hole in an inaccessible place such as close to a shoulder, it is sometimes out of the question to use an ordinary tap wrench. A wrench with a square hole in the end is the usual resort. In the illustration is shown an adjustable wrench of this type. It is made from a piece of flat, cold rolled steel, ½ inch thick, one inch wide and about four inches long, shaped as shown in the

sketch and tapped for a ⅜ inch headless setscrew. Owing to the notch cut in the end of the setscrew, it is obviously necessary to turn the latter to approximately the required distance before inserting the tap.

Contributed by

AL. MORRISON.

Hack Saw Lubricant

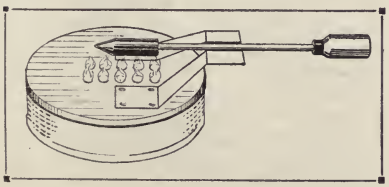
The writer has found that a lubricant composed of two parts tallow and one part graphite makes a hack saw cut faster and "sweeter." The lubricant is of great assistance in parting a stubborn piece of steel.

Contributed by

DANIEL W. SANDERSON.

Alcohol Lamp for Soldering Iron

A handy heater for small soldering irons may be made from an old shoe polish tin. The cover of the can is drilled or punched with a double row of holes and a support of heavy sheet metal is affixed as shown in the illustration. The can is filled with cotton waste and the latter saturated with alcohol. The cover is replaced and a lighted match held over the holes. The lamp will burn with a hot blue flame and a soldering iron placed on the holder will be heated quickly. If the heater is to be used in a drafty place—near an open window during hot weather, for instance—a hood may be bent up from tin and secured over the lamp.

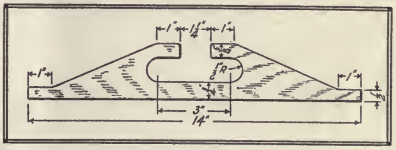


Contributed by

R. N.

A Broom Holder

A holder to keep the broom from sliding from the wall to the floor can be made with little effort. The device serves the additional purpose of offering an incentive to keep the broom in one place



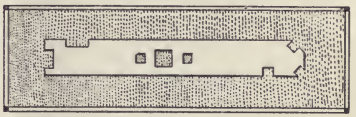
where it can be found when wanted. The illustration shows the construction clearly and no further explanation is necessary.

Contributed by

RUBEN ANDEREGG.

Handy Wrench for Lathe

In the illustration is shown a design for a very handy tool for use on a lathe. The wrench is made from a piece of ¼ inch cold rolled steel, 1¼ inches wide and of proportionate length. The slots at the right hand end may be made to fit tool holders, the slots being cut at an



angle to facilitate reaching the tool. The space between is sharpened to a screwdriver wedge. The three openings in the center of the tool are for different sizes of taps and reamers, while the remaining slots are to fit the dogs used on the lathe.

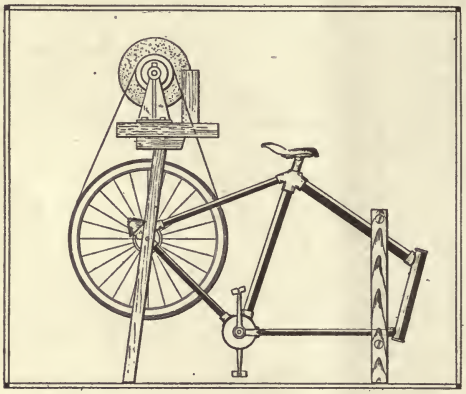
Contributed by

CLARENCE H. ANDERSON.

¶ Don't fail to read the announcement appearing on page 289.

Foot Power Emery Grinder

An emery grinder suitable for the amateur mechanic, the handy man or the small shop or farm where there is no other means of power, can be easily and cheaply built from an old bicycle.



To build the grinder a chainless bicycle without a coaster brake is preferable, although a chain bicycle could be used with a guard over the chain and sprockets. The front forks and handle bars and the rear tire are removed and the seat post turned backward. Wooden legs are carefully fitted and bolted to the frame. The tall (now front) legs are fitted with horizontal supports and the table screwed or nailed on.

The stand is a small polishing head, procurable at most city hardware stores, and the emery wheel is ¾ by 6 inches and rather coarser than those furnished with small hand grinders. In the machine built by the writer the flanges of the polishing head were only one inch in diameter and the hole in the emery wheel one inch, but a snugly fitting wooden bushing was turned up from an empty thread spool and the flanges were enlarged by putting a two-inch washer on each side of the emery wheel.

The belt is a heavy cotton line spliced together to fit taut.

A tool rest is built from ⅞ inch board and held in position by a small screw clamp.

The grinder is used almost daily by the writer for sharpening cold chisels, drills, plane irons, carpenter tools, kitchen knives, garden hoes and shovels, axes, etc., and is a big saving on files for rough filing.

The total money cost was $2.00 for the emery wheel and polishing head. The bicycle was one that was discarded and the few pieces of lumber, bolts, screws, nails and paint were picked up about the house.

Contributed by

J. Hoeck.

Sharpening Scissors

A pair of scissors may be sharpened by drawing the blades over the surface of a glass bottle just as though the bottle were being cut. If this operation is repeated several times, the scissors will be given a good cutting edge.

Contributed by H. Drobe.

A Coat Hanger for the Workshop

A coat hanger that will prove a boon to the workman in the shop, keeping the clothes well up and out of the way, can be made by tapering a piece of wooden strip about three feet long, boring a hole in the end and securing a coat hook near the hole. A nail is driven in the wall about 8 or 9 feet from the floor and above the workman's bench. On this nail the hanger can be placed without the necessity of climbing up on the bench.

Contributed by

L. G. Burnand.

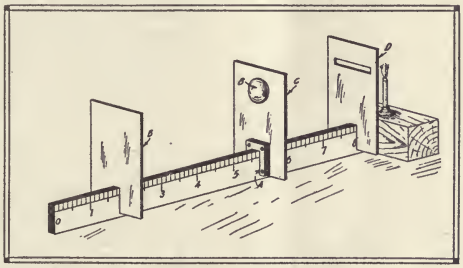
¶ One dollar will be paid for every idea accepted and published in this department.

FINDING THE FOCUS OF A LENS

By H. J. Gray

It is often a matter of importance to know the exact "focus" or "focal length" of a given lens. This applies particularly to those who use lenses in the construction of cameras, enlarging apparatus, or any other appliance for optical or photographic purposes.

Any lens that is thicker at the center than at the edge will throw an image of an object upon a screen, and will bring parallel rays of light together so as to meet in a single point of focus. Such lenses are termed convex lenses. They may be convex on both sides, or one side may be flat or even concave, but so long as the thickness is greatest in the middle they all behave in the same manner. The image or likeness of an object produced by a convex lens is called a "real image" because it can be thrown on a screen. Concave lenses, which have their thinnest part in the center, produce an image which is called a "virtual image" because it can only be seen as if apparently floating in the air and cannot be projected on a screen. The former type is by far the most common and it is with this form of lens that we have to deal in the present article.



In the illustration *A* represents a long, flat rule divided into inches and tenths of an inch. A white cardboard screen, *B*, is supported in a vertical position above this rule in any convenient manner, as well as a piece of perforated cardboard, *C*, with a lens fixed over the hole by means of wax or glue, or gripped by rubber bands, while a third sheet of cardboard, *D*, with a narrow slit cut in it at the same height as the lens, is placed at the end of the rule. This forms the object which is illuminated by a candle placed behind it. If *B* and *D* are fixed, and *C* is moved to and fro until a position is found in which a sharp image of the slit is thrown upon the screen, it will be possible to find the focal length of the lens by a very simple calculation.

Suppose the distance between the lens and the slit, or object, is 2 inches, and between the lens and the screen 5 inches. If we write u for the first distance, and v for the second, representing the focus by *f*, then we have

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

That is: $\frac{1}{2} + \frac{1}{5} = \frac{7}{10}$.

And if $\frac{1}{f} = \frac{7}{10}$, then $f = \frac{10}{7}$, or approximately 1.43 inches.

The calculation is more conveniently made, however, as follows:

Using the same letters to signify the above or any other distances found by experiment,

$$\frac{u \times v}{u + v} = f.$$

In the above example this will be:

$$\frac{2 \times 5}{2 + 5} = \text{approximately 1.43 inches.}$$

In practice, one decimal point will be found sufficient.

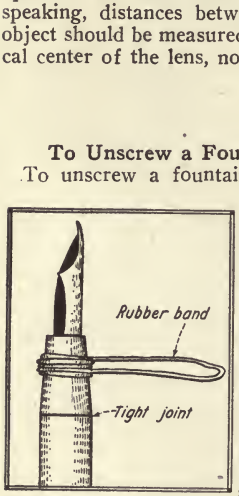
A yard stick may be used as the scale, fixed vertically along a plank which serves as a baseboard. The cardboard screens should be stiffened with thin wood at the back and can easily be made to slide along the scale by fixing them to small blocks of wood slotted underneath. A large hole should be made in the wooden holder that is to carry the lens. Separate cardboard screens that have holes

of different sizes can be provided, and these are held in position by means of a rubber band at each end.

The slit which forms the object is best made in thin brass fixed over a larger aperture in the cardboard. Strictly speaking, distances between screen and object should be measured from the optical center of the lens, not from the surface of the glass. However, as the thickness of a lens is usually a very small fraction of its focal length, except in the case of very short focus lenses, the error due to neglecting this point is scarcely appreciable. For most purposes it is quite sufficient to know the focal length of a lens to within a tenth of an inch.

To Unscrew a Fountain Pen

To unscrew a fountain pen that has become firmly stuck together, wind a rubber band around the neck several times, keeping it tightly stretched while winding. The rubber will provide a grip that enables the user to unscrew the pen with but little difficulty.

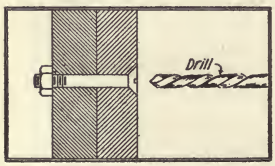


Contributed by

W. F. SCHAPHORST.

To Remove a Rusted Bolt

To remove a bolt that has rusted in place, a drill may be run through the head until the shank is reached, after which the bolt can be driven out. Obviously, the drill should be of the same size or a little larger in diameter than the shank of the screw.



Contributed by

M. L. MEYERS.

Cushion for Rubber Stamp

When using a rubber stamp, a piece of felt placed beneath the paper will greatly assist in making a uniform impression. If this cushion is used, it is not necessary to strike so heavy a blow with the stamp.

Contributed by

RUSSELL WALDO.

A Simple Chemical Glow Lamp

A phosphorescent glow lamp may be made by placing a piece of yellow phosphorus in a bottle and then pouring over the phosphorus a small quantity of olive oil heated to the boiling point. A cork placed in the bottle completes the lamp. To operate the lamp it is necessary to remove the cork letting in a small quantity of air. The phosphorus will glow brightly for some time, giving off sufficient light to enable one to find a keyhole or switch in the dark. The glow seems to fill the entire bottle.

Contributed by

R. N.

¶ Remember, the April issue of this magazine will appear under the new title THE WORLD'S ADVANCE. Read the announcement on page 289 of this number.

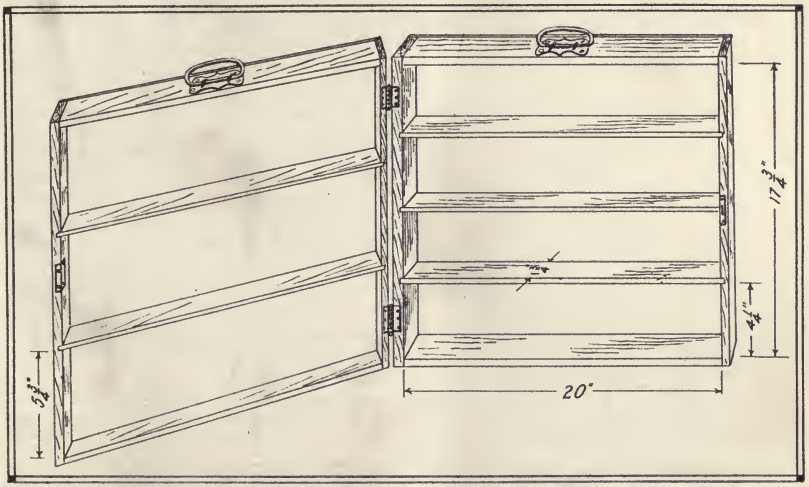
Student's Chemical Outfit

By E. Swetman.

MANY students for whom chemistry has a special attraction are deprived of the pleasure of actually doing experiments because they have not access to a laboratory. The importance of experimenting while one is studying chemistry can hardly be over-estimated, for nothing can develop the powers of observation and reasoning more readily than the study of the reactions that take place before one's eyes. Experiments even of a simple nature are interesting and instructive, and serve as an aid to remembering otherwise vague reactions that would be soon forgotten.

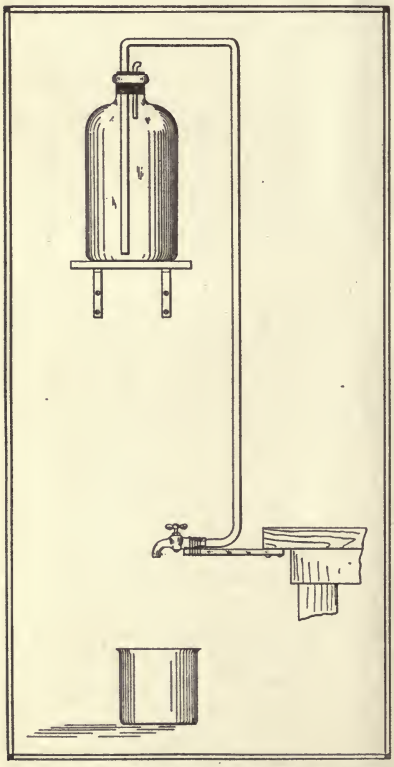
With very little expense the chemical outfit to be described can be set up, and it is amply serviceable to enable one to study all the reactions necessary for ordinary qualitative analysis. The writer had available one corner of a room, and it was accordingly necessary to set up a very compact outfit.

To begin with, a table at least three feet long is necessary. This is best covered with a sheet of moderately thick glass, for glass can always be kept clean and it is impervious to the action of chemicals used. On the table and against the wall stands the reagent case, which takes



Dimensioned Sketch of a Case for Holding the Bottles of Chemicals. Shelves Built in this Manner Facilitate the Transportation of the Outfit.

most suitably the form shown in the illustration. The frame of the case is made of half-inch material, while quarter-inch stock is used for the shelves and sides. It is provided, of course, with hinges, a lock and brass handles, and when closed presents a very neat appearance if properly finished. It has the desirable feature of being portable. The advantages of a case, such as is illustrated, over a set of open shelves on the wall, are that it can be closed and locked when not in use, thus keeping out dust and light, as well as possible meddlers. Furthermore, it is quite as portable as an ordinary suit-case. The dimensions given in the diagram were found most suitable, but can be altered for other needs. This case will hold all the chemicals required.



A "Waterworks" System to be Used by Experimenters who do not have Access to Running Water.

Reagents are usually bought as solids, and the solutions made therefrom as required. One side of the case is reserved for all the solid reagents; four dozen salt bottles of one or two ounce size being easily accommodated. A one-ounce bottle contains quite enough of a salt to make all the solution necessary for a course of experiments. For instance, a molar-tenth solution of cobalt chloride is all that is required, and an ounce of this salt in solid form will make considerably more than two litres of solution of this strength. The writer procured, however, three dozen one-ounce salt bottles and one dozen of two ounces capacity; the larger ones being used for the common salts, such as of copper, iron, ammonium, etc., which may be used a great deal. Square salt bottles with aluminum tops are perhaps the best, for when these are returned to the shelves after use the labels are more easily kept uniformly in front than in the case of round bottles, which is quite obvious.

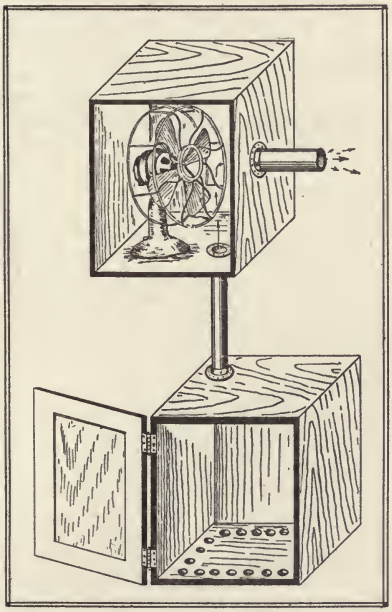
The other half of the case accommodates the solutions, which are kept in glass stoppered bottles of four- and two-ounce capacity. The four-ounce bottles are used for the acids, two for each acid, to contain them both in dilute and in concentrated form. Similar bottles are supplied for the hydroxides of sodium and ammonium, ammonium sulphide, ether-alcohol, bromine water, milk of barium carbonate,—that is, the reagents most frequently used. Of course, these can be refilled easily at a nearby drug store at little cost. Smaller glass-stoppered bottles can fill up the remaining space, these containing solutions of the salts of metals being studied at the time, in order to save preparing fresh solutions constantly. Indeed, there is room in the case described for some of the metals of each group.

On the bottles should be placed paper labels of the proper size, the names of the compounds or their formulæ being written on the label in black, indelible ink. Care must be taken when pouring the acids and solutions to have the labels

always on the upper side so that the drip will not run down over the label and efface the name thereon. The writer has found that, with care, paper labels are quite satisfactory and lasting.

A list of reagents can be secured from any textbook on analysis, and four dozen can be selected that will fill all requirements.

The apparatus next engages attention A liberal supply of water must be at hand and when no water pipes are con-



A Fume Hood fitted with Piping and Fan Blower for Carrying away Gases.

venient, as was the case with the writer, a small "waterworks" system has to be set up. A large bottle, of from one to five gallons capacity, is supported on a shelf two or three feet above the table, and by means of some half-inch tubing the water is siphoned down to a tap secured to the end of the table. The stream of water issuing from the tap has a considerable and sufficient force for all needs. A crock is placed beneath the tap to hold waste water and solutions. A bottle of distilled water is also necessary for preparing solutions of reagents.

If the student intends studying qualitative analysis, a small hydrogen sulphide generator is necessary, a very efficient one being described by the writer in the February issue of MODERN MECHANICS. It is suitable also for generating hydrogen or carbon dioxide.

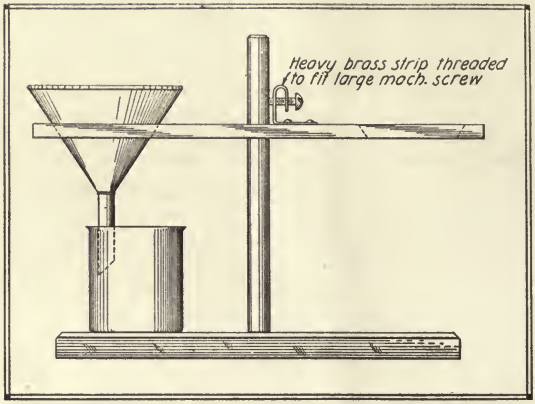
Alcohol Lamp and Stand.

For heating and boiling solutions, if gas is not available, an alcohol lamp may be used with good results. A stand for supporting beakers over the flame is easily constructed, as shown in the illustration; heavy copper wire of about No. 10 size being used to support the wire gauze that is placed at all times between beakers and the flame, in order to distribute the heat and prevent cracking the glass.

A fume-hood is necessary to carry off vapors, fumes, and poisonous gases from boiling solutions and heated solids. One which well serves the purpose may be made of a large, tin, cracker box. The lid is made into a door by securing it to the box with small hinges. A glass window is fitted into the door for the purpose of watching the progress of operations inside. The bottom is perforated, and tin piping of about two-inch diameter leads from the top of the box to the window of the room and thence to the open air. The writer found it necessary to create a slight, forced draught, so that fumes would go through the pipe and not back out into the room. This was accomplished by enclosing a small battery fan motor in a box, just at the end of the pipe, as shown in the illustration. The sketch furnishes a clear idea of the entire fume-hood.

A Simple Wash Bottle.

A couple of test-tube racks, each with a capacity for a half-dozen six-inch test-



A Filter Stand that may be Readily Constructed with Materials Usually Found about the House.

A filter stand remains to be constructed. The accompanying diagram gives the clearest idea as to how this may be done.

To complete the equipment, several beakers are required, as well as filter funnel, with filter paper to fit, a porcelain evaporating dish, a small crucible, a piece of platinum wire, a pair of tongs for removing hot beakers, a glass stirring rod, and some blue, red, and violet (neutral) litmus paper.

This completes the description of a chemical experiment outfit that has proved an invaluable aid to the writer in studying qualitative reactions and has made the hours of many a long evening very profitable and intensely interesting.

tubes, are soon made. For washing precipitates, a liquid dispenser, known as a "wash-bottle," is necessary, and may be made with a small florence flask, a double-hole rubber stopper and some glass tubing, as shown.

NOVEL WIND INSTRUMENT DEVICE

Added possibilities for orchestral composition are revealed in a new device just perfected by Bernard Samuels, a noted European musician. Competent judges in the world of harmony on this side of the water believe his "Aerophor" will greatly advance scoring for wind instruments, by tinting future compositions with new and strangely beautiful harmonies and will also prove a blessing to the musicians themselves by saving their health and nervous energy.

It provides a means of holding a tone indefinitely, while the performer is resting his lungs. This is accomplished by foot pressure on a dust-proof bellows. A small bellows, operated by one foot, supplies the air. Connected with this is a rubber tubing which terminates in a small metal reed fastened near the mouthpiece of the instrument. Both the reed and the regular mouthpiece are held in the mouth of the musician. By a sort of stop-cock, both are controlled.

THE SIZE OF AN ATOM

In a lecture delivered last spring, Sir Oliver Lodge gave a striking illustration of the incredible minuteness of the atom. The amount of gold in sea-water, although very small, seems considerable when stated in atoms, for a single drop of sea-water contains 50,000,000 atoms of gold. That stupendous figure, however, indicates merely one-fiftieth of a grain in a ton of sea-water, and it would take 100,000,000 atoms to be visible under a microscope of the highest power.

The next issue of this magazine will appear under the new title "The World's Advance." Don't forget the name.

A HANDSOME SEWING CABINET

Describing the Construction of This Attractive Piece of Furniture, With a Few Words Concerning Mahogany as a Cabinet Wood

By Ralph F. Windoes

Illustrations from drawings made by the author.

AMONG the so-called "luxuries" that the American woman of today is justly demanding is a convenient place in which she may keep her sewing and her sewing supplies. Nothing will litter up a home quite as rapidly as the numerous pieces, parts and patterns that are needed in the proper performance of this household duty. Therefore, let our home craftsman consider the feelings of his over-burdened wife, mother or sister and keep her numerous sewing necessities together by making a sewing cabinet.

In our series this month we are offering a cabinet that has a great many advantages over the more "freaky" styles such as are found in our furniture stores and gift shops. In the first place, all of her pieces and supplies are kept under cover, making them almost dust proof if the drawers fit properly. The top is flat and reasonably large, 16″ x 24″, making it possible to cut and fit without the necessity of a separate sewing table. The drawers all pull from one side, allowing her to sit in a chair close by the cabinet and reach whatever she desires. There is ample space for all necessities, the top drawer being partitioned off for spools, shears, etc., the second left clear for miscellaneous supplies, and the two large drawers at the bottom for patterns and cloth. Finally, the appearance of the cabinet is very attractive—it might easily pass for a small serving table if left in the dining room.

The sewing cabinet requires but little stock to build, hence it is rather inexpensive. The choice of wood is left to the craftsman, though we will recommend mahogany, if it can be obtained, as it will not cost much more than quarter-sawed white oak, and the difference in price is well worth the money.

A few words concerning mahogany as a cabinet wood may not be out of place at this point, as the craftsman should have some understanding concerning all materials with which he works if he is to use them intelligently.

The only true mahogany grown in America comes from the West Indies and Central America. In addition to these localities, West Africa furnishes the mahogany supply of the world.

It is interesting to note the first use of mahogany. According to tradition, it

was utilized to repair some of the ships of Sir Walter Raleigh's fleet at Trinidad, in 1597. As a furniture wood it was introduced to the world a little later in England, by a Dr. Gibbons, who had a small box made of it and a bureau. The latter attracted the attention of the Duchess of Buckingham, who begged enough wood from the doctor to have it duplicated for herself. From that day until this it has been the chosen wood of royalty and the peer among cabinet woods.

The true mahogany is a very hard wood to work and is exceedingly scarce, hence less than half of the lumber sold to-day under that name is true mahogany. Among the substitutes can be found "Columbia mahogany"—and it is in no way related to true mahogany—and "crabwood" from Guiana, the latter being the principal substitute employed at the present time by furniture makers.

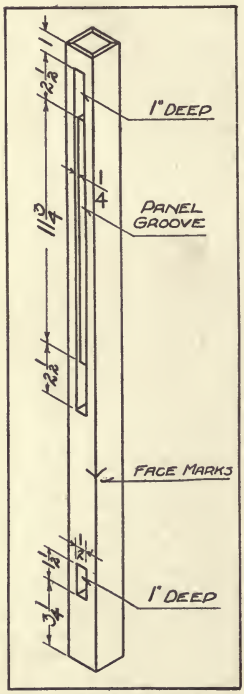


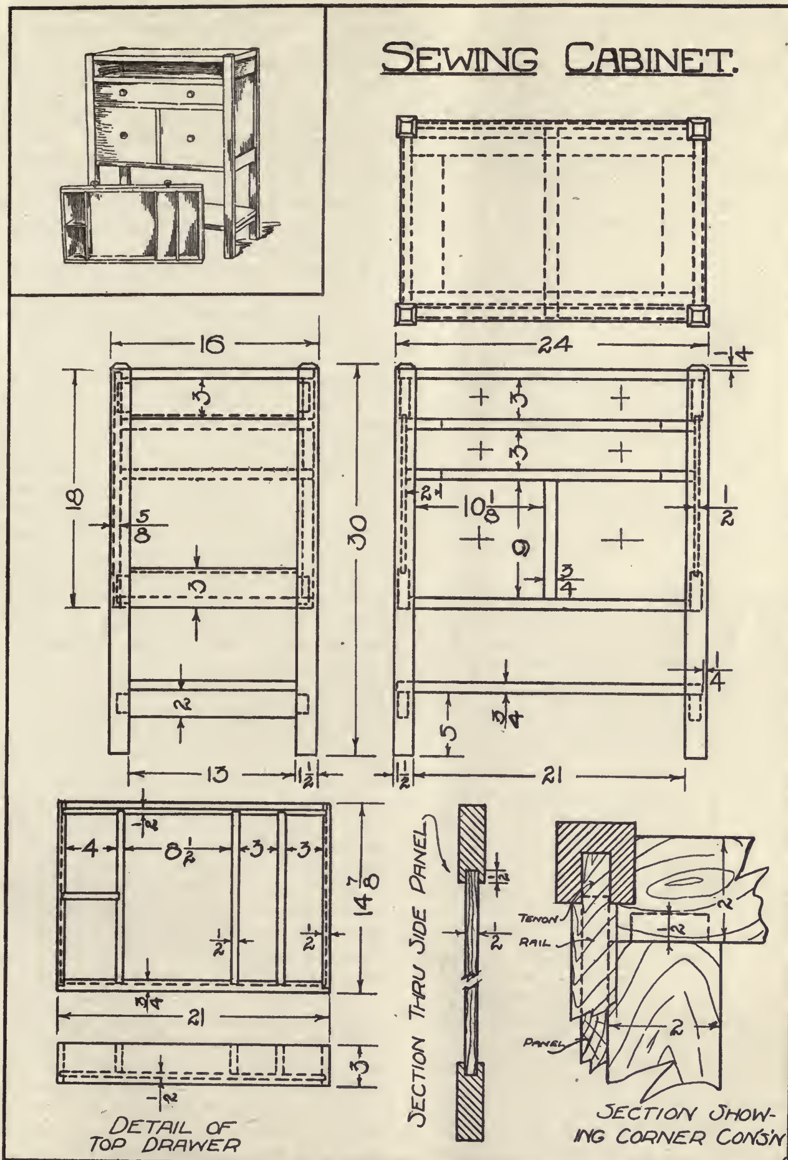
Fig. 1.—Detail of Inside Corner of Leg.

Though no true mahogany grows in the Philippines, a great deal of wood is being imported into this country and sold as mahogany. *Narra,* the best and most expensive, is used rather extensively in California. It is yellow, red, or nearly white in color, hard, readily worked, and rather coarse grained.

Red Lauan, also a Philippine mahogany, is red to reddish brown, light, rather soft, straight, coarse grained, and is sold rather extensively in this country as plain mahogany.

Of course, there are other substitutes for mahogany—a large number of them—and the craftsman must be guided more by his common sense than by the word of the dealer as to whether or not he is getting the genuine article. Obviously, if he is paying a low price he may expect a substitute, but if he is being "held up" he surely wants to receive what he is paying for. And remember, in judging mahogany, that there are two never failing tests that can be made—weight and hardness. If the wood is a rich, brownish red in color, heavy (from 45 to 65 lbs. per cubic foot) and very hard (can not be dented easily) it is probably mahogany. But if it is light (baywood, a common substitute, varies from 29 to 35 lbs. per cubic foot) and can easily be dented, it is not true mahogany, even though it is called by that name by a reliable dealer.

But let it be understood that we are not condemning all of these substitutes in the above discussion. We have seen some very beautiful pieces made from them and so colored that it was very difficult to distinguish them from the genuine article, and we will admit that it is very much easier to work up the substitute in a piece of furniture than would be the case with true mahogany; but what we do object to is the practice of selling and calling a piece "genuine mahogany" when it is a substitute, and this practice should be fought by the consumer to the last ditch. We have seen furniture—made from *prima vera,* often called "white mahogany," bought by the manufacturer for $180 per thousand—sell for "genuine Spanish mahogany" when the latter could not be obtained in the market at any price, and the customer would pay the exorbitant charge and walk away well satisfied with his bargain. He did not know that genuine mahogany had sold in the Liverpool auction rooms at $3.00 a board foot at this same time. Of course, at this price it was highly figured stuff and was cut up into very thin veneers. But the point



General Details of the Sewing Cabinet as Well as a View of this Piece of Furniture When Completed, with One of the Drawers Removed.

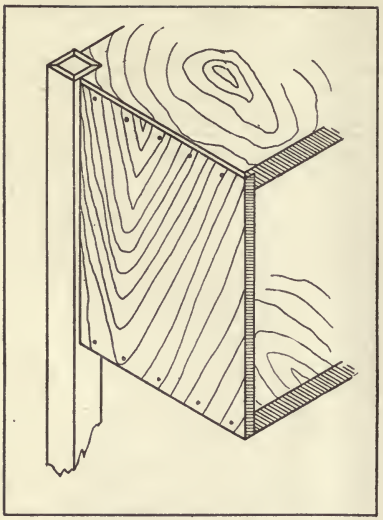


Fig. 2.—Section Through Back, Showing How it is Fastened to Top and Bottom of Cabinet.

is this—the substitute wood makes very good furniture when properly finished, never costs the dealer more than 17 or 18 cents a foot, and it should be sold in the stores at a proportionate price and under its own name. It is deception when practiced in any other way.

Let our craftsman purchase as he can—substitute or genuine—but let him see to it that he gets full value for money expended. He will need the following stock for the sewing cabinet:

Legs, 4 pcs. 1½"x1½"x30", mahogany.
Top and bottom, 2 pcs. ¾"x15½"x23¾", mahogany.
End rails, 4 pcs. ¾"x3"x15", mahogany.
Stretchers, 2 pcs. ¾"x2"x15", mahogany.
Lower shelf, 1 pc. ¾"x13"x23½", mahogany.
Drawer fronts, 2 pcs. ¾"x3"x21", mahogany.
Drawer fronts, 2 pcs. ¾"x10⅛"x9", mahogany.
Partition, 1 pc. ¾"x15½"x9", mahogany.
Fronts of frames, 2 pcs. ¾"x2"x22", mahogany.
Side panels, 2 pcs. ½"x13½"x12¼", mahogany.
Back, 1 pc. ⅝"x21½"x17¾", birch.
Backs of frames, 2 pcs. ¾"x2"x22", birch.
Sides of frames, 4 pcs. ¾"x2"x11⅞", birch.
Drawer sides, 4 pcs. ½"x3"x14⅝", birch.
Drawer backs, 2 pcs. ½"x2¼ x20½", birch.
Drawer bottoms, 2 pcs. ½"x14⅝"x20½", birch.
Drawer partitions, 3 pcs. ½"x2"x13⅝", birch.
Drawer partition, 1 pc. ½"x2"x4½", birch.
Larger drawer sides, 4 pcs. ½"x9"x14⅝", birch.
Large drawer backs, 2 pcs. ½"x8"x9⅝", birch.
Large drawer bottoms, 2 pcs. ½"x9⅝"x15⅝", birch.

The birch will stain up to a close imitation of mahogany and, if carefully applied, will finish so that it will be difficult to distinguish between the two woods. This stock should, of course, be cut to very exact dimension and should be sandpapered at the mill.

Begin the construction by cutting the mortises in the legs. A study of either the working drawing or the detail in Fig. 1 will give the necessary dimensions. Notice that the face marks, which indicate the "working faces," are on the inside corner of each leg. These will not be working faces unless they are at right angles to each other. Lay out each mortise before cutting any one of them, and place the legs in their relative position to each other to be very sure that they have been correctly layed out. Cut them very carefully and accurately according to the directions that have already been given in this series.* Notice the "panel groove" in the detail, which the side panels and the back fit into. Where the former will be placed, the groove is cut out ½" wide and ¼" deep on the inside faces of the legs between the mortises, and where the back will enter the legs, the grooves will be ⅝" wide and ¼" deep. The legs are chamfered on the top ends.

Next lay out and cut the tenons on the side rails, also rout out grooves for the top and bottom ends of the side panels, as shown in the "Section Through Side Panel" on the working drawing. The stretchers are the same length between shoulders as the side rails and should be cut accordingly.

Now assemble the sides and clamp them up dry to see that all parts fit snug. If they do, the builder may go ahead and glue them up, or he may wait until all cutting and fitting has been done. Mahogany will not shrink and swell very much, hence there will be no need to make any great allowance for this when fitting the panels.

* See January number of MODERN MECHANICS.

The next step is the building up of the two frames upon which the 3″ drawers slide. On the working drawing may be seen a section showing the corner construction. The frames are made of 2″ pieces, mahogany for the front strips and birch for the back and side strips. Notice in the detail given that the sides are tenoned into the front and back strips, and glued. Notice, also, that the sides rest against the panels and that the corner of each frame is cut out for each leg. This cutting must be very accurately done or a crack will be left where the front piece joins the legs.

Next, the bottom piece must be cut off and fitted between the lower side rails, as seen in the front elevation. In fitting this board and the frames, be sure that you have made allowances on the back side for the back piece. This will bring a ¼″ leg projection on the front and ⅛″ leg projection on the back.

If the side sections are glued up, the builder may begin to assemble at this step. A glance at Fig. 3 will show how these pieces are put together. Beginning with the bottom board, turn the cabinet upside down and clamp this piece in its proper place. Of course, it will be necessary to place at least one of the frames in position in order to keep the legs parallel. Place one of the straight plates where it belongs and mark around it. Chisel down into the wood the depth of the plate and screw it in place. Repeat with three on each side and the bottom is secure.

Next fasten the lower shelf by screwing up into it from the under side of the stretchers, which should make the cabinet real rigid. At this step slide the back into position and fasten it at the bottom with nails or flat head screws, as shown in Fig. 2. Fit the top in place by cutting out around each leg, and rabbet it on the back edge for the back piece to fit into, as is also shown in the same sketch; but do not fasten the top at this point. Taking the lower frame, place it into position exactly 9″ up from the bottom board and nail or screw into it through the back, holding it at the front edge with two angle irons, according to Fig. 3. Put the partition in place and hold it with flat head screws up through the bottom piece and down through the lower frame.

The upper frame is held in the same way as the lower, but it will be necessary to screw the angle irons into the frame before putting it into position. As its top edge will rest against the lower edge of the top rails, it will be an easy

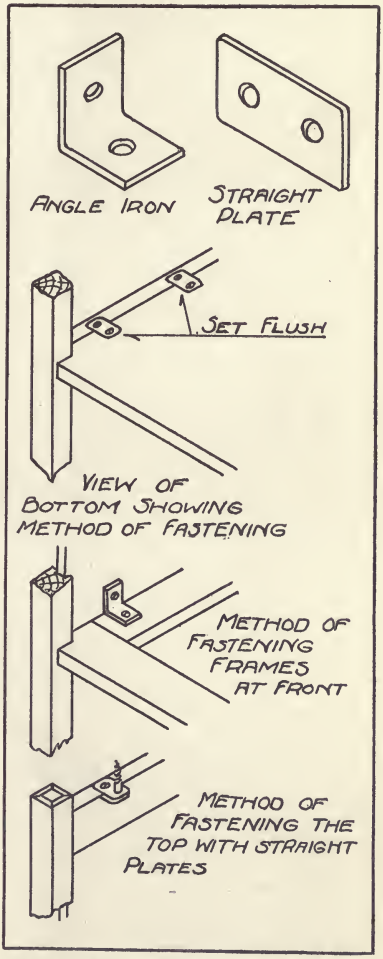


Fig. 3.—Methods of Fastening the Different Members.

matter to place it straight.

Finally, fasten the top. The nails or screws through the back will hold it on this edge, while two straight plates in each end will secure it. (See Fig. 3).

The drawers are constructed according to the detail given on the working drawing. The fronts are of mahogany and the linings of birch. The partitions are only placed in the top drawer. When fitting these into the cabinet, it will be necessary to fasten a little strip of wood along the inside faces of the rails and the side panels to build them up even with the legs and prevent the drawers from sliding in crooked.

If all of this work has been carefully done, the craftsman is ready to clean up the piece and apply the finish.

The wood must be in perfect condition, carefully sandpapered and dusted. It must also be entirely free from visible glue, oil, or grease of any kind. Obtain the dark mahogany oil stain and apply it according to the directions found upon the can as it comes from the manufacturer. Use a soft brush and be very careful not to show any brush laps. When perfectly dry, sandpaper very lightly with No. oo sandpaper. The object in sandpapering is twofold: it smooths down the grain raised by the stain, and it throws up the high lights by removing a portion of the stain from the markings in the wood. If a second coat of stain is desired, it should be applied sparingly with a piece of cloth or waste. Next apply a *light coat* of *thin* shellac, and when this has set perfectly, sandpaper it down very carefully. The object in this shellacing is to protect the solid parts of the wood against discoloration by the filler. That is to say, the thin film of shellac does not fill the grain to any great extent, allowing full ingress of the filler where it is needed; and again it makes an impervious coating over the solid structure, preventing the wood from absorbing the filler where it is not wanted and permitting of readily removing the filler by a light sandpapering after the filler has become dry. It therefore enables a much cleaner job to be done than would be possible without the shellac coat, it overcomes the muddy or cloudy appearance that is sometimes seen, and also enhances the beauty of the finish by making more distinct contrast between the high lights and low lights. The foregoing accomplished, apply a coat of dark mahogany paste wood filler, thinned out to the consistency of thick cream. When this has lost its brightness, rub it into the grain of the wood with your fingers or a piece of leather, and wipe clean with waste or old cloth. This should fill the open grain up even with the surface of the surrounding wood, but if it does not, allow it to harden and apply another coat in the same manner. Sandpaper this a little when dry and shellac the entire piece. After a few hours, sandpaper this shellac and apply the first coat of varnish. The varnish must be the best grade of hard oil furniture varnish. Use a new fitch flowing brush, carefully brushing it over the hand to remove all dust there may be in it. Apply plenty of varnish so it may even drip off the work, then wipe off with the brush from which the extra varnish is removed on the edge of a dish. This will allow the coat to "flow" more evenly over the work. Set to dry in a dustless place, giving it all of the time the specifications call for on the can before "rubbing it down." This may be done with *very fine* worn-out sandpaper or fine steel wool. Be very careful of the edges and do not rub through the varnish in any spot. Apply a second coat of varnish in the same way as the first and, when this is perfectly set, rub it down with powdered pumice stone and water. To do this, dip a felt pad into the water and then into the pumice, lifting a sufficient amount of the latter to the work to secure a smooth, unpitted and even surface when carefully rubbed with the pad. *Be very careful of the edges* and do not rub through them. Wipe perfectly clean with a damp sponge and dry with chamois skin. This will give the dull "egg-shell" finish. If a polished surface is desired, rub this with rotten stone and oil, or rotten stone and furniture polish, to a gloss of the desired degree.

The addition of drawer pulls and casters finishes the piece.

DESIGN FOR A SMALL DYNAMO*

Description of the Construction of a 30-Watt Generator of Simple Yet Efficient Design.

By Chas. F. Fraasa, Jr.

Illustrations from drawings made by the author.

IN the February issue the main mechanical details of the construction of the 30-watt generator were covered at length. With the previously described work completed, the builder is ready to proceed with the remaining mechanical details as well as the electrical work.

For the shaft, procure a piece of 5/8-inch machine steel rod. Center the rod in the lathe and turn the ends down to 7/16-inch in diameter for a distance of 1⅞ inches. The central portion, 2¾ inches long, is turned to 9/16-inch in diameter and threaded on the ends *A* and *B*, Fig. 8, 12 threads per inch for a distance of 5/8-inch. Procure two blank hexagon nuts and tap them 9/16-inch 12 threads per inch.

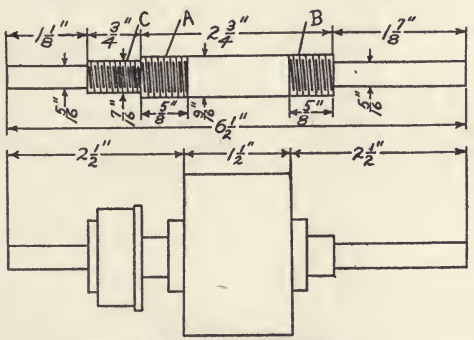


Fig. 8.—Steel Shaft for Armature.

The armature laminæ, Fig. 9, are made of No. 29 sheet steel. Cut enough 2½-inch discs to make a stack 1½ inches thick when tightly compressed. Cut two discs of ⅛-inch iron and clamp the sheet iron discs between them. Drill a 9/16-inch hole through the center of the stack and mount the discs on the shaft between the heavy discs. They should then be drawn tightly together in the center of the shaft by means of two hexagon nuts previously provided.

Mount the shaft in the lathe again and inscribe a 1⅞-inch circle on the ⅛-inch disc on the end of the core. This circle should then be divided into twelve equal parts, each of which locates a slot. The armature is then taken from the lathe and these points center punched and drilled clear through the core, using a 5/16-inch drill. Insert 5/16-inch bolts in these holes to prevent the tool from tearing the teeth and turn the core down to 2¼ inches in diameter. The ⅛-inch discs on the ends of the core may now be removed, since they were employed merely to facilitate the drilling and turning of the core. Replace the hexagon nuts, drawing the core tightly together in the center of the shaft, and turn the nuts off to a thickness of 3/16-inch. The slots are to be opened by a ⅛-inch cut made by placing two or three blades in a hacksaw frame, to secure the proper width of cut. The armature discs will then appear as in Fig. 9. The shaft is completed by turning it to the dimensions, Fig. 8, and threading the portion *C* for the commutator, 14 threads per inch, for a distance of ¼-inch from the end.

The commutator, Fig. 10, consists of a number of copper bars *A* insulated from one-another and clamped together by the rings *B*. The bars are also insu-

* This is Part II of this article. The first part appeared in the February issue.

lated from the clamping rings. The insulation of the commutator consists of mica applied with shellac. The mica insulation is shown by the heavy lines *D* between the bars and over the rings. The nut *C* holds the clamping rings together.

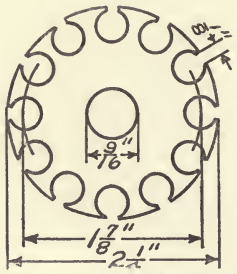


Fig. 9.—Armature Laminae of Sheet Steel.

The commutator bars are made from a copper casting or, better still, a copper forging turned to the dimensions indicated in Figs. 10 and 11. The casting is chucked and rough turned to within 1/16-inch of the finished dimensions. Then divide the circumference into 12 equal parts and with a screw slotting milling cutter, cut along these lines to within 1/16-inch of cutting through. This cut may be made with a hacksaw if no milling cutter is available, but the saw blade should be ground very thin. Then split some mica to the same thickness as the tool which made the cuts in the casting and shellac each piece liberally and place them in the slots. The commutator should then be baked and laid away to dry.

The rings, *B*, Fig. 10, are dimensioned in Fig. 11 at *A*. Two of these turned from iron or brass will be required. The nut *C*, Fig. 10, is dimensioned at *B*, Fig. 11. This is also made of iron or brass, only one being required. It should be bored out and threaded 7/16-inch 14 threads per inch.

Turn up a ring *A*, Fig. 12, having an internal diameter of 1⅜ inches, ⅜-inch wide, and 3/16-inch thick. Around the circumference of this ring, drill and tap twelve equally spaced holes for the ⅛-inch screws, *B*. The commutator, *C*, is then placed in this ring and the screws turned up tight against it, one screw in the middle of each segment. Chuck the commutator and bore the center out to ⅝-inch. This will cut away the copper remaining between the segments. The

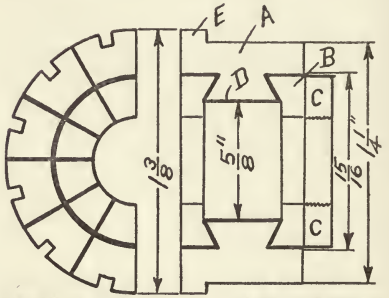


Fig. 10.—A Cross Section of the Commutator and One of its Segments.

commutator is then taken from the lathe and the flame of a blow pot directed on it to boil out the surplus shellac. The screws, *B*, Fig. 12, should then be turned up evenly around the commutator, drawing the segments together as the shellac boils out. When the shellac is boiled out, turn the commutator to the inside dimensions given in Figs. 10 and 11.

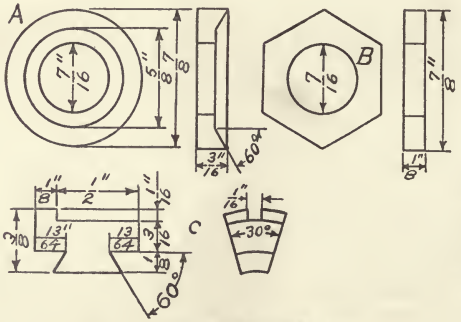


Fig. 11.—Parts of the Commutator.

The rings, *B*, Fig. 10, should be insulated with mica before assembling the commutator. Split some thin mica and cover the rings with it where they come

in contact with the commutator segments, using thin shellac liberally to stick it to the ring. Then slip one of the rings up against the shoulder on the shaft, wrap a 3/8-inch wide piece of mica around the shaft up against the ring, and put the commutator in place. Then put the second ring on and turn on the nut, tightening the commutator in place. Direct the flame of a blow pot on the commutator to boil the shellac out of the insulation on the rings. Tighten up the nut as the shellac boils out. Then remove the outside ring which holds the segments together and turn the commutator to the dimensions indicated in Figs. 10 and 11, leaving the ridge, *E*, Fig. 10. In the center of this ridge, on each segment, cut a 1/16-inch slot 1/16-inch deep for the connection leads from the armature.

Fig. 12.—Ring for Holding Commutator.

The brush holder, Fig. 13, is finished by boring the central hole, *A*, out to 7/8-inch in diameter, and drilling the holes *B* 3/16-inch. The hole *C* is drilled and tapped for a 3/16-inch set screw. The brushes are made of three leaves of No. 24 copper or brass, *D*. The piece *E* by which the brush is mounted on the brush holder is cut from 1/16-inch sheet brass. The three leaves of the brush *D* and the piece *E* are sweated together on the end which is mounted in the holder. The leaves are free on the other end which should be shaped out to the curvature of the commutator. The brush is mounted on a 3/16-inch rod *F*, through the hole *B* in the brush holder, and clamped between the nuts *G* and *I*. The nut *I* binds the rod to the rocker arm. Where the rod passes through the rocker arm, wrap a piece of insulating material around it and place a washer of the same material under the nuts *G* and *I* to prevent grounding of the brush. When assembling the brushes be sure to test for grounds.

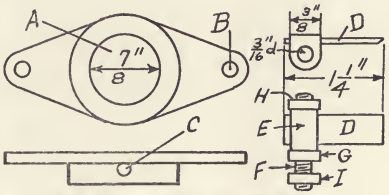


Fig. 13.—Details of Brush Holder.

Before winding the machine, it would be well to assemble the parts and see that everything runs true. Secure the field poles in place and adjust them so that the air gap is 1/32-inch all around the core on both ends. Then drill a 1/16-inch hole through the yoke ring into each pole and drive a piece of 1/16-inch steel wire into it to prevent its turning. When everything is adjusted, dismantle the machine and prepare for winding the armature and field magnet.

Wrap several layers of paper on the shaft on each side of the core, and shellac well. Cut out several discs of tough wrapping paper and stick them to the ends of the core with shellac. When this is dry, cut the paper away from over the slots and put a trough of tough wrapping paper in each slot, making it long enough to project on each end of the core for a distance of 1/8-inch, so that the wire will have no possible chance to come in contact with the core.

The armature is wound with No. 23 d. c. c. magnet wire and consists of 12 coils of 30 turns each, making 60 turns per slot, or a total of 720 conductors. The winding should be very carefully done in order to get the required number of turns in the slots. When the armature is wound, shellac well and then bake it.

Fig. 14.—Winding of the Armature.

Figs. 14 and 15 show how the armature is wound. Numbering the slots from 1 to 12 in consecutive order around the core, wind coil 1 in slots 1 and 7; leave out a loop between slots 1 and 2, and wind coil 2 in slots 2 and 8; coil 3 in slots 3 and 9; coil 4 in

slots 4 and 10; coil 5 in slots 5 and 11; coil 6 in slots 6 and 12, leaving a loop between succeeding coils. The next six coils will occupy the top half of the slots already wound. Coil 7 will then be wound in the top of slots 1 and 7; coil 8 in top of slots 2 and 8; coil 9 in top of slots 3 and 9; coil 10 in top of slots 4 and 11; coil 11 in top of slots 5 and 11, and finally, coil 12 in top of slots 6 and 12.

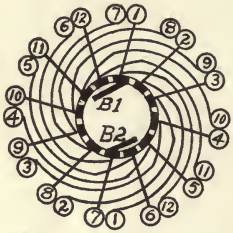


Fig. 15.—Scheme for Connecting Armature Windings to Commutator.

The connections to the commutator are made by connecting the loops between the coils to the adjacent commutator segments. The wire in the loop should have the insulation scraped off and then be driven in the slots in the end of the segment and soldered. If the coils have been properly wound, and connected, the paths through the armature should be as follows: Referring to Fig. 15, (1) B 1-12-12-11-11-10-10-9-9-8-8-7-7-B 2, and (2) B 1-1-2-2-3-3-4-4-5-5-6-6-B 2. This, together, with the winding diagram, will be useful in tracing out the winding and connections should there be any difficulty with the armature.

The shunt field winding consists of 843 turns of No. 25 s. c. c. magnet wire per pole, making a total of 1,686 turns on both poles. The wire should be wound on a spool made with a central core 1 5/16-inch in diameter, with a winding space 5/8-inch wide between the sides. Cut four saw cuts in these sides so that when the coil is wound, a tie string may be wrapped around it at four points around the coil to hold the turns in place while taping the coil.

Wind both coils in the same direction, taking care to wind the wire evenly and in layers. When the coil is wound, dip it in an insulation varnish or thin shellac, and bake it. Then wrap a layer of friction tape over each coil. The ends of the wires on each coil should have a short piece of lamp cord soldered to them for terminal connections.

After the coils have been placed on the field poles, they are connected in series with one another. The two ends of the coils are connected together, leaving the beginning of each coil for the connection leads. The connection should be such that when a direct current flows in them, it will flow in opposite directions around the two cores, making one a north and the other a south pole.

After the two coils have been connected in series, they should be connected in shunt with the armature. Fig. 16 shows the connections of the shunt type of winding. Only a portion of the current generated in the armature flows through the field winding, but the full armature voltage is impressed upon it.

The terminal binding posts are 3/16-inch rods threaded and provided with four nuts for each. The rod is passed through the yoke ring and a nut turned on each end. An additional nut is turned on each end to retain the connections. Where the terminal passes through the yoke ring, it should be well insulated by wrapping insulation around the rod and placing an insulation washer under the nuts to prevent grounding of the terminals with the yoke.

Before starting the machine as a generator, magnetize the magnetic circuit of the machine with a battery current. It will then retain sufficient residual magnetism to enable it to start generating. The brushes should be placed on a neutral point between the pole tips, and the machine brought up to speed. Running as a generator, the brushes should be given a little lead in the direction of rotation; as a motor, a little lead back of the direction of rotation. The output running at 2500 r.p.m. should be 15 volts

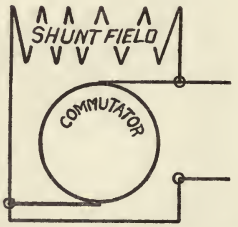


Fig. 16.—Connections for the Generator.

2 amperes, though 3 amperes could be carried for short intervals.

This dynamo will operate satisfactorily as a motor for furnishing motive power to toys, light machinery, window displays, etc. It is obvious that the power will not be great, but it will be found ample for most requirements usually expected of battery motors of the larger sizes.

INJURIES FROM ELECTRICITY

FOR the most part the injuries resulting from electric shocks are suffered by linemen, by workers in power houses, or by brakemen on electric railways who happen to touch the third rail. But with the increase of trolley lines in city and country and with the extension of transmission systems carrying currents of enormous voltage over long distances by means of wires strung on poles, the danger to the general public is constantly increasing.

Most of the accidents are produced by alternating currents. This is not because such currents are more dangerous than direct current, but because they are usually of higher voltage. It is not known how high the voltage must be to cause death. Much depends upon the mode of contact—whether the current passes through only a small part of the body, as when the two points of contact are in the same arm or leg, or whether it passes from one arm to the other or from the hand to the foot. A partial degree of insulation may also prevent serious consequences; for instance, when one is standing on perfectly dry ground or when the contact is made through the clothes.

An English authority on medical electricity states that it has been proved that a man with dry clothing can sit on the third rail, which carries a direct current of 550 volts, and grasp one of the other rails without receiving any shock whatever, but the experiment is not recommended to the curious.

When one has received a severe electric shock which has not been immediately fatal, he presents signs of greatly lowered vitality. He is unconscious, or semi-conscious, with almost imperceptible pulse, irregular and feeble respiration, cold, clammy skin, relaxed muscles and dilated pupils.

If he is still in contact with the live wire the muscles may be strongly contracted and it may be difficult to release him. Anyone who attempts to drag him away should have his hand protected by rubber gloves or by a dry coat folded several times, and he must see that the place where he stands is dry and that his foot is not in contact with a rail.

The treatment consists mainly in stimulation of the heart and respiration. Aromatic spirits of ammonia or some other stimulant should be given if the man can swallow, and artificial respiration should be practiced. This may be done by placing the person flat on the ground and compressing the chest firmly but gently for a few seconds and repeating sixteen or eighteen times a minute. The legs should be raised and the arms and legs rubbed in a direction toward the body. At the same time hot bottles may be applied to the body.

A NEW PROJECTILE OF ODD DESIGN

A new projectile, something between a torpedo and a shell, has been submitted for consideration to the French Minister of Marine. It glides and skims the surface of the water like a flat pebble, and has a range of nearly 10 miles. It can be fired from either a torpedo tube or a 12-inch gun, and contains a charge sufficient to destroy dreadnoughts or a breakwater. The method of firing is simple, and can be effected from a conning tower without the use of the telemeter. It is not a mere freak idea, though as yet its military value remains to be established.

What a Noise Can Do

THROUGH the starting of a fire in an oil car attached to it, a car of powder blew up.

The concussion was tremendous in the way of destruction of property, but the sound effect was still greater. The sound of that explosion traveled over three hundred miles. Entirely independent of concussion or the power of explosive force, the sound force broke farmhouse windows as far as 300 miles away; it shook dishes off of shelves and broke them; it broke immense store windows 102 miles away and even caused temporary gales of wind to rise in forests 75 and 100 miles distant from the scene of the disaster.

Napolini, an Italian scientist of some note in the latter part of the eighteenth century, claimed one evening in a conversation he was having with some friends, that with a large tuning fork and at a distance of two miles from the bells of the main Campanile of Rome, he could cause the chief bell, known as "St. Cecilia," to ring. His friends agreed to pay for the expense of the tuning fork with the understanding that if he did not succeed with the experiment, he was to pay them. If he did succeed, he was to be at no expense and all the glory was to be his.

An immense tuning fork was constructed, one of the largest ever known to man. A tuning hammer was also constructed with which to strike loudly a correct musical note on this fork. On a given night, Napolini and his friends, with the authorities of the city, gathered on a roof-top of a house which afforded an unobstructed line of sound or sound wave current to the bell of St. Cecilia. Creditable witnesses were placed at the Campanile and every legitimate precaution taken to see that no one touched the levers which controlled the six bells in this immense tower. The tuning fork was set up, and, grasping a hammer, Napolini began regularly to strike the fork. For about five minutes there was no evidence that his experiment would prove successful; but suddenly the bell of St. Cecilia began to give forth a musical response. It finally rang out so clearly that it could be heard by those on the housetop. Its companion bells gave a fainter response, but there was a clear indication of harmonious relation in musical sounds, and Napolini was upheld as to his theory that sound has an extraordinary power.

It is only within the last thirty years that the study of sound has been taken up by experts. This has been largely for the purpose of showing that every effort should be put forth to diminish sound in human life. The hum of the trolley car, the grinding of elevated trains, the useless rattling of wagons, wild screams that are uncalled for, harsh tones in the human voice, all have a serious and destructive effect on human thought, human nerves, the digestion and the value of human action in general.

MAKING WHITE PAPER FROM BLACK

The paper of old newspapers and old books is used over again to make cardboard and coarse wrapping-paper. It is difficult, however, to produce white paper from waste printed paper. Various attempts have been made to dissolve the oily or resinous portion of the printing-inks with solutions of soap, petroleum, caustic sodas and so forth, in order to wash away the black pigment afterward. There has been invented a process for removing the ink pigment by treating the printed paper with boiling solutions of borax. The hope is expressed that this method may act as a check on the rapid deforestation of this country and avert a condition that has threatened to cause a crisis in the paper industry.

Don't fail to read the important announcement appearing on page 289 of this issue.

THE CRYSTAL COFFIN

by

HEREWARD CARRINGTON

A VERY simple yet effective illusion which is often presented on the vaudeville stage is that known as the "Crystal Coffin." The trick, as it appears to the audience, is as follows:

The performer draws attention to a long, coffin-shaped box which is hanging several feet above the center of the stage and clear of the back drop and sides. The sides and ends of the coffin are of glass, so that it is possible to see through it and observe the curtain at the back of the stage. The coffin is suspended in the air by four steel chains.

The performer's assistant is now introduced—generally in the person of a beautiful and lithe young woman—and placed in the coffin. The lid is closed and the young woman can be readily seen lying in the coffin. Suddenly the magician fires a pistol several times and the audience looking through the glass coffin notices that the assistant is no longer there. In a moment or two, however, she is seen running down towards the stage from the rear of the house. She steps up on the stage and, after bowing to the stupefied audience, retires.

The secret of this clever illusion lies mainly in the construction of the box-like receptacle in which the young lady is placed. Although the coffin appears to be built wholly of glass as shown to the audience, it is not so in reality. The top and bottom of the coffin are of wood, while the sides and ends are of plate glass. But by manipulation and clever presentation, the performer can almost always leave the impression with the audience that the entire box is made of glass.

The illusion depends for its success on the top and bottom of the coffin. The top lid is so hinged that it swings outward; and underneath it is hinged, so as to swing inward, a mirror which exactly fits the under side of the wooden lid. The mirror is normally kept in place against the under side of the wooden lid by means of a spring bolt that may be released upon pressure of a spring. When the mirror falls back, it comes to a position diagonally across the crystal coffin. In the meantime, the coffin has been pulled up a little on one side by assistants in the flies, who pull the chains a certain, specified amount when the pistol is fired.

The under side of the mirror is painted so as to resemble the under side of the lid proper, to which it is attached. The under side of the lid is lined with black cloth, exactly matching the black cloth which hangs as a curtain at the rear of the stage. At a little distance and in fairly dim light, anyone looking into the coffin assumes that he is seeing through its glass sides to the rear curtain, even though it is tilted. As a matter of fact, however, the audience only sees the reflection of the under surface of the lid, which, since it matches the back drop, gives the impression that the coffin is empty and transparent.

When the mirror falls into place upon pressure of the proper spring, the rear half of the coffin is left as a hollow, triangular space, and it is here that the assistant hides. She is held there and concealed by the mirror which has fallen in front of her. The ends of the mirror would be seen were it not for the fact that two strips of wood or black paper run across the ends, apparently to make it solid, but in reality to conceal the ends. These pieces run diagonally from corner to corner.

The method of working the illusion can now be explained. When the assistant is placed in the coffin, she places her hand on the spring, ready to press it. At the moment the magician fires his pistol, she presses the spring catch and thereby causes the mirror to fall in front of her. At the same instant, the two assistants in the flies pull up the front end of the coffin in such a manner that the mirror slants at the proper angle for the view of the audience. The girl is then hidden from view and the coffin appears empty.

The girl who comes from the rear of the house is, of course, a confederate dressed exactly the same as the girl hidden in the coffin. The art of facial makeup makes the illusion complete. Such differences in appearance between the girls as there might naturally be are not perceived by the audience, since the second girl does not remain on the stage a sufficient length of time to be carefully studied. Of course, a few moments are allowed to elapse before this girl makes her appearance at the rear of the theatre, for the suspicions of the audience would be aroused if she appeared immediately after the pistol shots were fired. As it is, the audience assumes that the girl placed in the coffin has made her escape.

A NEW METAL WHICH MAY REPLACE RADIUM

Zeitschrift fur Schwachstromtechnic is the authority for the following story. If it appears improbable, as it certainly does, it must be borne in mind that we would have been equally incredulous, no doubt, if we had been given a description of the properties of radium twenty years ago.

In the mountains of Namangan, territory of Ferghana, Turkestan, there has just been discovered a new metal having powers so unusual as to surpass even those of radium. An explorer picked up a number of small pieces of metal of a dirty brown color and of great weight. He carried some of it to Moscow and there left it at a chemical laboratory for examination. The chemists made a number of experiments which gave some very surprising results. When the metal was placed in an acid it at once developed a very low temperature and caused the immediate disintegration of the glass containing vessel. When this was replaced by vessels of stone or porcelain, the result was the same. Finally an iron vessel was used; this also was reduced to powder. The chemists then tried a heavy receptacle of granite, with the result that this also was disintegrated without the production of gas or explosion of any kind, but with the same lowering of temperature. When the metal was treated with an alkali it lost twenty per cent. of its weight. Then the chemists were sent to Turkestan to get a fresh supply, which, after considerable search, they found and brought back to Moscow. Further experiments indicate that the new metal has valuable curative properties. One of the most striking observations made so far is that substances brought into contact with it invariably lose weight. Russian scientific circles are united in the belief that the world is on the eve of an enormous surprise, perhaps even greater than that produced by the discovery of radium.—J. H. BLAKEY.

Over the new trans-continental telephone line the voice travels from New York to San Francisco in 1/15th second, or at a rate of 56,000 miles per second. If a man could shout loud enough to be heard over that distance, the sound would take four hours to travel the 3,400 miles of air.

Making a Fac Simile Rubber Stamp

By Edward F. Hallock

FOR those who turn out duplicate letters in large quantities, a fac simile rubber stamp of the signature to be placed on the mail matter is a great convenience. The making of such a stamp is not a difficult matter and can readily be undertaken by anyone who can handle a camera and vulcanize a patch on an inner tube.

The first operation in the process of making a signature stamp is to write the signature which is to be copied. The name should be written on white Bristol board in jet black ink, preferably drawing ink, and should be half again the size of the normal signature, so that when it is photographed it will not lose too much detail. The card bearing the name is then tacked up before a camera and brought to a sharp focus on the ground glass plate, it first having been ascertained that the object is the correct distance removed from the lens to bring the name on the plate to about the normal size.

With the object sharply focused, an exposure is made on a slow plate such as is normally used for copying purposes and with a small lens aperture in order that the detail may be as sharp as can be obtained. The plate is developed in a bath that gives good contrasty negatives, a standard, slow hydrochinone developer is to be recommended, and then, to make the impression more effective, the plate is intensified in the usual manner.

The negative having been completed to the satisfaction of the operator, a process plate is prepared in the following manner: Ordinary carpenter's glue, well washed to eliminate the last trace of dust or grit, is allowed to swell in cold water until it has taken up all the water it will absorb. The glue is then melted in the usual manner in a double boiler, without the addition of any more water. It is allowed to cook for a couple of hours, in order to drive off a good portion of the moisture

The plate can be an old photographic negative or a common piece of window glass. It is cleansed and then coated with the glue, which has been skimmed to rid it of the froth which ordinarily collects on the surface of the liquid. Care should be exercised in coating the plate to make sure that a film of even thickness is applied to the plate. This can best be done by pouring a quantity of the hot glue in the center of the plate and then tilting the plate first in one direction and then the other, until the glue has reached every portion of the surface. If the tilting is carefully done, the glue can be so manipulated that it will not run over the edge. The plate should then be placed on a perfectly level surface to dry.

When the plate has dried out thoroughly, it is sensitized by immersing it in a solution of bichromate of potash in water, in the proportion of ten parts of water by weight to one of the bichromate. The plate is allowed to stay in this solution, which should be cold, of course, so as not to melt the glue, until the film has swelled to its fullest extent for the second time and then it should be placed on edge to dry in a dark place. The plate should not be allowed to remain in the liquid longer than is necessary to

swell the glue fully, for otherwise it will frill and bubble.

When the plate has dried out for the second time, it will be found that the chemical has so affected the glue that if it is exposed for a short time to the light, it will lose all power of absorbing water and swelling; and it is this effect of light on the glue that is utilized in the process of making the fac simile stamp. The plate is placed under the negative in a printing frame, just as if it were a piece of photographic paper or a lantern slide, and the frame then is placed in strong sunlight for from ten to fifteen minutes. When the plate is removed from the frame it will be found that the signature is printed on it in deep brown against the light brown color of the sensitized glue.

Development is effected by placing the glue in a cold water bath and allowing it to remain there for several hours. Upon examination it will be found that all portions of the plate, save the signature which alone was exposed to the rays of the sun, have swollen with the water absorbed. The signature then is left intaglio in the glue film and the relative height of the swelled and the unswelled portions is such that when a plaster cast is taken from the glue plate, the name stands out in bold relief to such a height that good clear prints can be taken from it.

The plaster cast is very easily taken. The plaster is mixed to the consistency of cream, and then is worked into the lines representing the signature with a soft camel's hair brush; care being exercised to see that the plaster reaches the smallest crevice and that no air bubbles are allowed to remain. The plaster cast should be made sufficiently thick to give it strength so that it will not break when being handled.

When the plaster has set and hardened, which will be in about an hour or even sooner, provided a little salt has been added to the water in which it is mixed, it can easily be removed from the glue film and, as was stated before, will bear the signature in bold relief. The plaster, however, is hardly suitable to print from, so it is necessary to make another intaglio mould similar to the glue mould, but this time made from the more substantial plaster.

To do this, the face of the plaster cast is well greased with either lard or tallow in order to prevent it sticking when the soft plaster is poured against it. Care should be taken in greasing the surface to get the grease into every little space around the lettering, for otherwise trouble will ensue. The plaster for the second cast should be mixed the same as before and should be manipulated into the smallest crevices of the signature with the brush in the same manner. The second cast should be made quite thick and substantial for it will have to stand considerable pressure when it comes to vulcanizing.

When the plaster has hardened the two casts can readily be separated, provided care has been taken to see that all portions of the first cast were greased before pouring the second cast, leaving the signature complete to the last detail impressed in the second cast. It is from this cast that the rubber stamp is actually to be made.

For the purpose a small gasoline vulcanizer, such as is used by automobilists for repairing inner tubes, is necessary. Plastic or under cured rubber, some of which comes with the vulcanizer and which is used for repairing punctures in the tubes, is carefully impressed into the lines of the signature. Before doing so, however, the plaster mold should be dusted with fine graphite to prevent the rubber from sticking. The rubber,

which is soft and pliable and which comes in thin sheets, is very easily pressed into the lines, and being plastic and not resilient, it will remain there. It should be applied one layer at a time for several layers until the stamp seems to have sufficient backing. Then the plaster cast is placed in the vulcanizer with the rubber on top so that the heated plate of the device bears directly on the rubber, and the clamps are tightened as hard as possible with the hands. Tightening the clamp is important, for it forces the rubber into the smallest crevices. Then the heater is filled with gasoline in the usual manner, save that half again the quantity used for an ordinary tube patch is put in, and ignited.

The process of vulcanization is allowed to continue until the fuel has burned itself out, when the plaster cast is removed from the vulcanizer and allowed to cool. This results in the rubber being fully cured and very resilient. It is peeled from the plaster, revealing a perfect reversed impression of the written signature. The rough edges of the rubber can then be trimmed off with a penknife and the stamp glued to a block of wood fitted with a handle, ready for use.

It will be found, of course, that in the process the signature will have suffered a slight loss of detail due to the numerous transfers, but on the whole the results will be highly satisfactory.

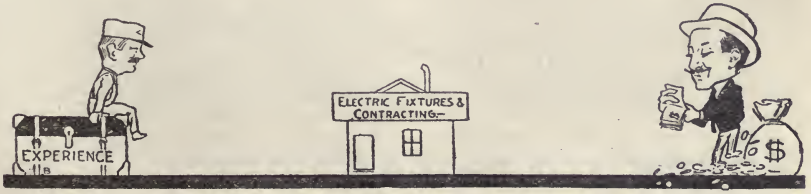
CLUES FOR THE ELECTRICAL CONTRACTOR

A MISTAKE often made is for the practical, hard working electrician to associate himself with a man of capital in order to equip and conduct an electrical contracting business, dependent wholly upon the size and general looseness of the capitalist partner's pocketbook. The sum and substance of such a combination is this: A has experience but no money, while B has money but no experience, so they combine forces. The result, in seven cases out of ten, is that the partnership is eventually dissolved leaving B short on capital and long on experience; and A is perhaps a wiser man for his experience.

Any one can place five hundred dollars with a partner of five years' experience, but it takes a thoughtful and practical business man to make a success of the combination. The chemist combines one part of oxygen with two parts of hydrogen to produce water; but if he should place these elements together in any other proportion, the result would be quite different. It is the same in the case in point. If capital and experience are not united in the one correct manner, then we cannot have success.

Then there is the question of office management. Too often so little attention is given to this important end of the business that a shop helper can guess as closely to the earning power of the company as the manager himself. We do not see this condition in a drug or a dry goods house, nor, in fact, do we find it in any line of paying enterprises.

In the ideal business, both the shop



manager and the office manager have good working ideas of each other's duties, but they never interfere with one another. The office manager can tell you at a moment's notice the amount of money expended during any given time or he can tell you the latest quotation on copper wire. The shop manager can, with equal facility, tell you how much time was spent in roughing in Mr. B's residence, or the condition of the stock room. This is truly the ideal condition, regardless of whether the company is a large one or whether the whole working force is represented by the owner.

Management as just described will succeed when work is slack and when the incompetent man closes his doors. It is the condition arrived at when the practical electrician with a certain amount of business training conducts his own shop, or when the man of experience and the man with capital combine forces in the proper manner.

Another source of destruction for the electrical contractor is the estimating department. This work unquestionably should come under the supervision of a man who is at once an experienced electrician and a shrewd business man. He must know how long it will take each and every one of his men to tape one joint; how long it will take a man to rough in a knob and tube job under the ever varying conditions of architecture; he must know personally every salesman who calls on his firm, in order to get the lowest quotations on short notice. I know men who can tell closely at a glance the cost of wiring a residence complete, but you must understand that they are men of experience who keep close watch on the time and material spent on various classes of work. They not only know that a house may be wired much more quickly when the joists and bridge work run just right, but they know how much more quickly it can be done. With the lively competition in almost every city or town, the man who guesses is going to lose out sooner or later. Get a man in your shop who does not guess but knows, and you will have an estimator who will bring profits to your door. Every means should be given him to obtain information regarding work.

If you are estimating your own jobs, you are doomed to certain failure unless you familiarize yourself with every detail connected with the business. A record should be kept of every piece of work done, showing the conditions met and the actual cost required to complete it. In this way you will be stowing away invaluable information for use at some future time. In other words, your business must be progressive. A membership in a contractors' association, a subscription to a good electrical journal and a well constituted library pertaining to electrical engineering are essential to a progressive firm.

Men are just as human as you make them. If you treat them as beasts of burden, then you can confidently expect their work to deteriorate. Help them over the rough spots and you will find them ready to put forth a little extra energy in your behalf. If you do not systematize your business as other contractors are doing you will eventually be among the losers.—J. S. BLAIR.

RECENT SUBSTITUTES FOR PLATINUM

The great increase in the value of platinum during the last few years has led many investigators to seek substitutes for it. It appears that the search has been partly successful. Platinum-clad nickel-steel wire is beginning to displace platinum wire in incandescent lamps; wires of nickel alloys are now making the cheaper grades of artificial teeth; asbestos threads are taking the place of platinum wires in gas mantles; and fused quartz ware has come into general use in chemical laboratories in the place of platinum utensils. Yet the introduction of these substitutes has not affected the price of platinum; the demand for the metal seems to have steadily increased in spite of them.

For the Handy Man

Edited by Thomas Stanley Curtis

A Library Dome in Wood and Art Glass

THE design offered in this article has been prepared with some misgivings on the part of the author as the project is not a simple one for the average amateur mechanic to handle The greatest care has been taken with the drawings, however, and it is hoped that by adhering closely to dimensions and then using a little ingenuity and judgment in the assembly, the builder will have but little difficulty in turning out a presentable piece of work. Certain it is that the finished article is one that will give unending satisfaction not only to its builder, but to all who have the privilege of reading beneath its genial rays. The lamps are so placed that the reader is never annoyed by having the direct rays from the filament shine in his eyes and at the same time the illumination on the book is excellent.

Referring to Fig. 1 and also to the wash drawing on the next page, the reader will note that the lamp is rectangular in form, 32 inches long, 16 inches wide, and suspended from a chain 60 inches long, or as long as may be necessary according to the height of the ceiling.

As the construction is, in general, similar to that of the lamp described in the preceding article of this series, the author will endeavor to specialize on the particularly difficult portions of the work

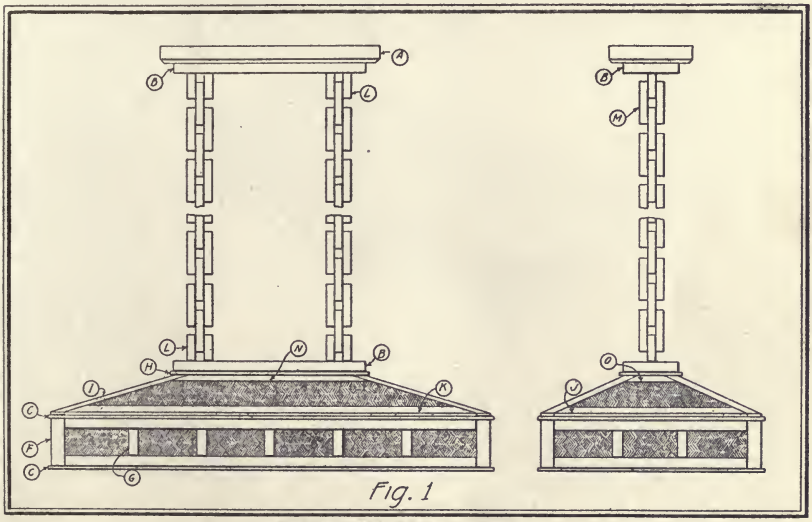


Fig. 1

Side and End Views of Dome.

rather than give a lengthy discussion of the points covered previously in other articles.

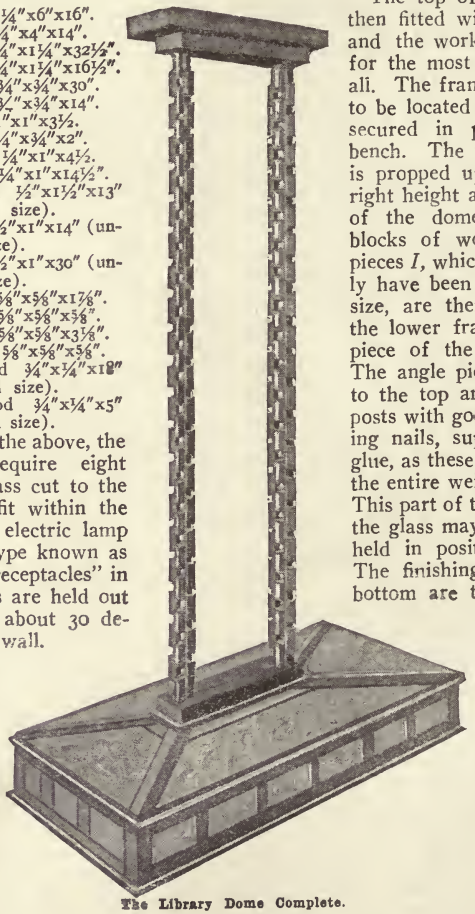
The bill of materials, as may be noted in the drawing of the details, Fig. 2, is as follows:

(*A*) 1 pc. wood 1¼"x6"x16".
(*B*) 2 pcs. wood ¾"x4"x14".
(*C*) 4 pcs. wood ¼"x1¼"x32½".
(*C*) 4 pcs. wood ¼"x1¼"x16½".
(*D*) 4 pcs. wood ¾"x¾"x30".
(*E*) 4 pcs. wood ¾"x¾"x14".
(*F*) 4 pcs. wood 1"x1"x3½.
(*G*) 14 pcs. wood ¾"x¾"x2".
(*H*) 2 pcs. wood ¼"x1"x4½.
(*H*) 2 pcs. wood ¼"x1"x14½".
(*I*) 4 pcs. wood ½"x1½"x13" (unfinished size).
(*J*) 2 pcs. wood ½"x1"x14" (unfinished size).
(*K*) 2 pcs. wood ½"x1"x30" (unfinished size).
(*L*) 8 pcs. wood ⅝"x⅝"x1⅞".
(*L*) 4 pcs. wood ⅝"x⅝"x⅝".
(*M*) 96 pcs. wood ⅝"x⅝"x3½".
(*M*) 96 pcs. wood ⅝"x⅝"x⅝".
(*N*) 2 pcs. wood ¾"x¾"x18" (unfinished size).
(*O*) 2 pcs. wood ¾"x¼"x5" (unfinished size).

In addition to the above, the builder will require eight pieces of art glass cut to the proper size to fit within the frame and two electric lamp fittings of the type known as "show window receptacles" in which the lamps are held out at an angle of about 30 degrees from the wall.

The lumber is to be ordered cut to the proper sizes at the mill if the builder wishes to save himself much uninteresting labor. The angles indicated in the drawings will have to be finished by the builder as the work progresses and it is in this feature of the work that the greatest difficulty will be experienced.

The frame is to be assembled by nailing the strips *C* to the corner posts *F* and then fitting in the side rails *D* with the decorative pieces *G*. This assembly can all be done with the aid of glue and slender brads. The construction must be substantial, however, as the lamp weighs quite a bit when completed.



The Library Dome Complete.

The top of the dome *B* is then fitted with the strips *H* and the workbench prepared for the most difficult feat of all. The frame of the lamp is to be located and temporarily secured in position on the bench. The top of the dome is propped up at exactly the right height and in the center of the dome by means of blocks of wood. The angle pieces *I*, which must previously have been cut carefully to size, are then fitted, joining the lower frame and the top piece of the dome together. The angle pieces are secured to the top and to the corner posts with good, strong finishing nails, supplemented with glue, as these joints must bear the entire weight of the lamp. This part of the work finished, the glass may be inserted and held in position with brads. The finishing strips top and bottom are then put on and the dome is complete with the exception of the two receptacles which are placed as shown in Fig. 2. The wires are passed through holes in the top piece and up the chains.

For the details of the chain construction the reader is referred to Fig. 1, as well as to the parts *L* and *M* in Fig. 2. The chains are built up of separate pieces of wood securely held together with nails and glue. The length of the two chains should be

(*Continued on page* 407)

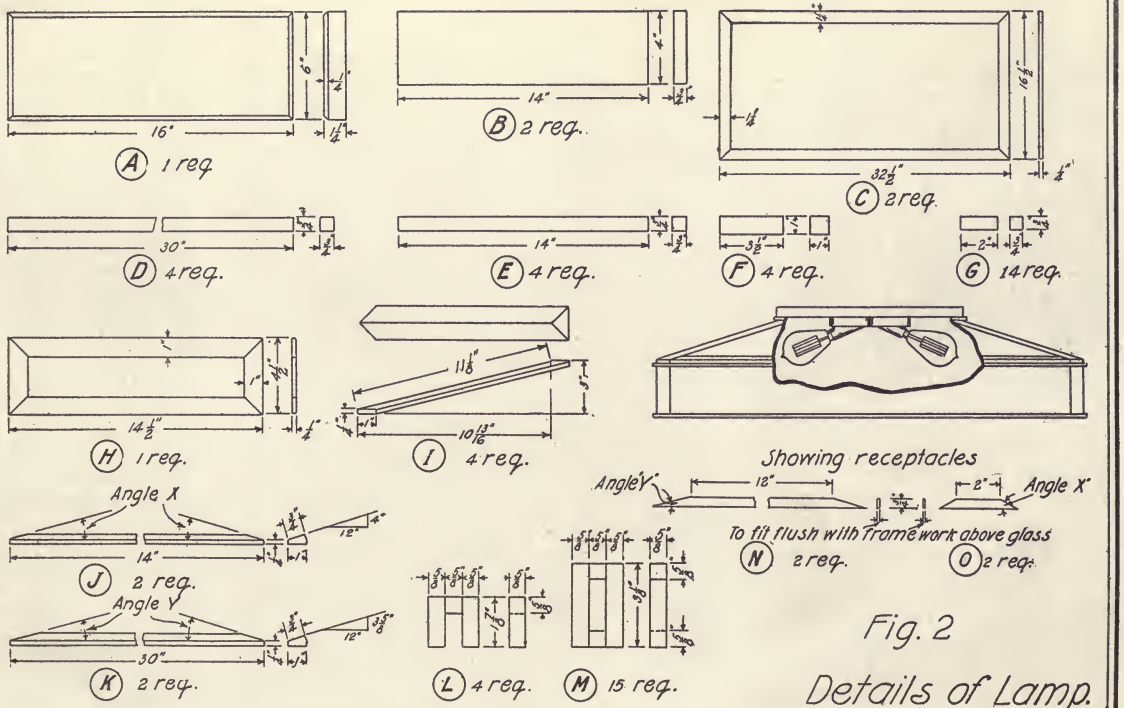


Fig. 2

Details of Lamp.

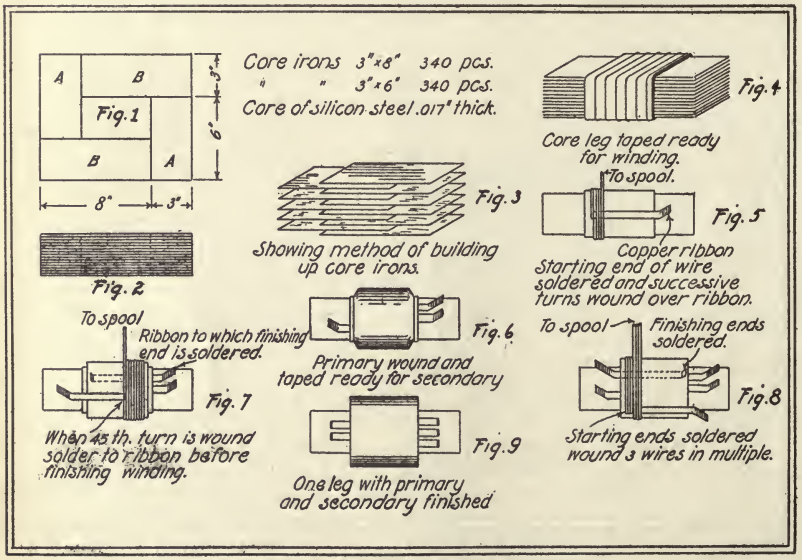
Electricity in Stagecraft

Edited by Thomas Stanley Curtis

Construction of a Welding Transformer

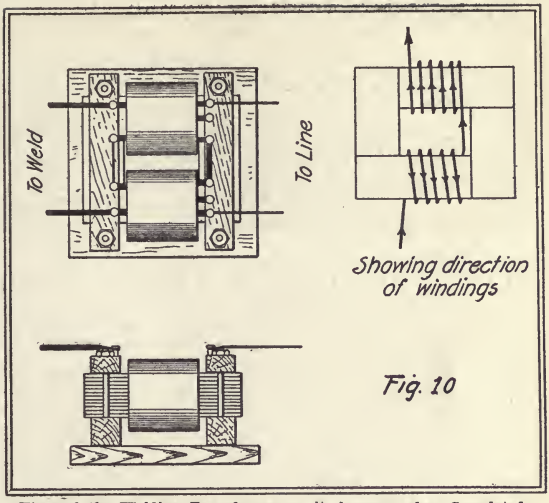
THE feat of grasping a piece of iron wire, as thick as a pencil, between two pairs of tongs held in the hands, and causing the wire to become red and even white hot while held in that position, is a stunt which seldom fails to call forth the applause of an audience. When the experiment is conducted with the proper scenic atmosphere, the effect is materially enhanced.

In this article the reader will find the details of the construction of a low-voltage transformer admirably adapted to this purpose. The transformer can be built by the average handyman who has a smattering of electrical knowledge and who knows the value of careful work as regards insulation. In the article to follow, the design of a suitable stage setting and accessories will be described. While this experiment may readily be made one of a number grouped up into a single offering, still it is quite complete in itself and with embellishments, it may form the basis for an act of a few minutes' duration.



Constructional Details of the Welding Transformer.

In order to make the description clearer, the various parts of the transformer will be described separately, each under its proper heading. The transformer is designed for operation on a 110-volt, 60-cycle alternating current circuit and when the load is applied, the current in the primary is approximately 26 amperes. The secondary current at 11 volts is in the neighborhood of 250 amperes and this is sufficiently large to make quite a display.



View of the Welding Transformer as it Appears when Completed.

THE CORE

The core of the transformer is of laminated iron or preferably silicon steel .017 inch thick and cut into pieces as indicated in Fig. 1. From the diagram the reader will note that two sizes are required, *i. e.*, 3 by 6 inches and 3 by 8 inches, respectively, and 340 pieces of each size will be needed. The steel for the core may be obtained cut to size and ready to assemble from certain transformer manufacturers who buy the material in large quantities and cut it with a gate shear.

Fig. 3 shows how the 3 by 8 inch pieces are assembled with the ends projecting alternately three inches first on one and then on the other side. The strips are divided into two piles of 170 pieces each and each pile is then built up as shown in Fig. 3 to make two cores, each three inches thick. A generous wrapping of tape and three layers of press board make the cores ready for the windings.

PRIMARY AND SECONDARY WINDING

The secondary is wound over the primary on each leg of the transformer. For this reason the primary winding will be considered first. As mentioned before, the winding described is for use on a 110-volt circuit; if the builder desires to wind for a 220-volt circuit, he should substitute twice as many turns of a wire three sizes smaller in the primary only. The windings here mentioned are figured at but 500 circular mils per ampere, but in view of the fact that the transformer is used for only a few minutes at a time, the heating will not be excessive.

The primary consists of 120 turns in all and so arranged that 90 turns may be used if desired. The winding is of No. 9 D. C. C. magnet wire in four layers of 30 turns per layer. Two layers are wound on each leg. With reference to Fig. 5, the winding is started by soldering the end of the wire from the spool to the end of a piece of stout copper ribbon which is then insulated with a layer of paper and the winding continued over it for one layer. This prevents the annoyance of the first turn coming loose after the winding is removed from the lathe.

Over the first layer of the primary is placed a layer of press board and then the second layer of wire is wound until the 45th turn is reached. At this point a tap of copper ribbon is taken as shown in Fig. 7. Over this the winding is continued until the 90th turn is in place. This turn is soldered to the tip of a third piece of ribbon previously placed so that

(*Continued on page 407*)

Electricity in Horticulture
Edited by Thomas Stanley Curtis

Plant Culture by High Frequency Current

Part I. The Construction of the Transformer

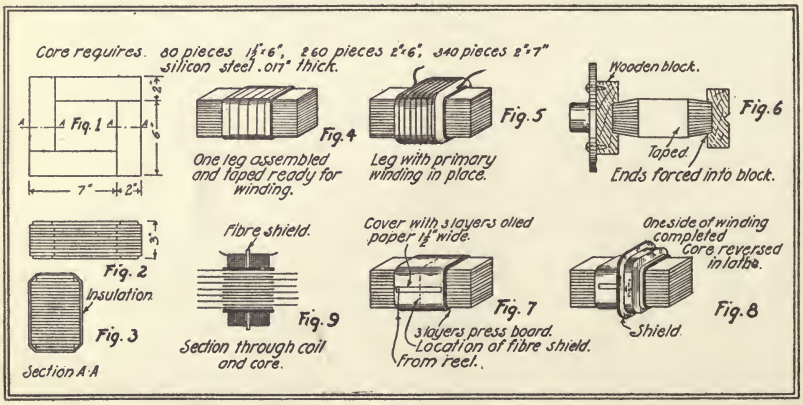
THE successful generation of an electric current at high potential and high frequency offers a problem not easy of solution, particularly if this current is to be put to practical use for long-continued periods of time. While there are several methods of producing the current, only one will be considered here as the others are deemed impractical for amateur use.

The generator to be described is designed for hard duty. The complete apparatus comprises a transformer, condenser, spark gap and an oscillation transformer. In the construction of the apparatus, a fairly complete electrical knowledge is essential. The high-voltage transformer must be carefully made and properly insulated, while the accessory apparatus requires not a little mechanical skill for its successful completion. Once constructed, however, the operation of the outfit is a simple matter and quite within reach of the average fruit or vegetable grower.

In order to simplify the explanation, the description of the transformer will be divided into sections, each bearing the proper heading.

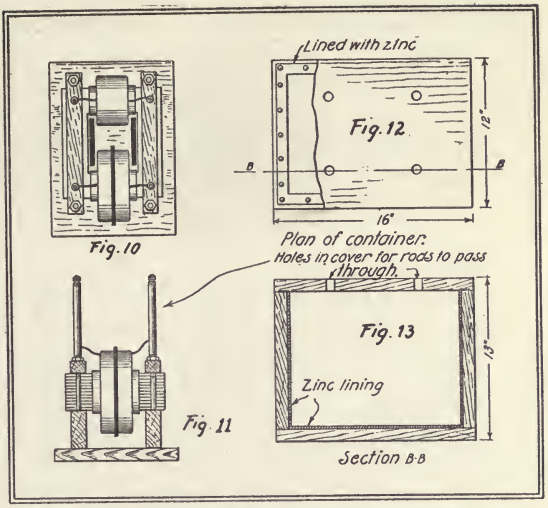
CONSTRUCTION OF THE CORE

The core is composed of thin sheet iron or preferably silicon steel which may be obtained from transformer manufacturers. The sheet metal is to be cut into strips according to the specifications given in Fig. 1. The 2 by 6 inch strips are divided into two piles of 130 pieces



Details of the Transformer.

each and these strips are assembled alternately with the ends overlapping two inches. The 1½ by 6 inch strips are next divided into four piles of twenty each and these are assembled alternately also. These packs are then to be placed above and below the assembled piles as shown in Fig. 3 to break the sharp corners. The piles are then wound tightly with tape and finally covered with several layers of press-board, preparatory to winding the primary and secondary.



The Transformer with its Container, Complete.

WINDING THE PRIMARY AND SECONDARY

The primary is wound on one leg of the core and the secondary on the other. The two cores are then joined in a complete magnetic circuit by the end yokes as shown on Fig. 1. The primary winding consists of 125 turns of No. 10 D. C. C. copper magnet wire wound 25 turns per layer and five layers deep. Between each two layers of wire, a turn of press-board should be taken. The first and last turns of wire are held in place with loops of strong tape placed under the winding and drawn tight after the turns are in place. No shellac or other paint is used on the winding as the coils are to be immersed in oil when the transformer is completed.

The secondary winding is in two sections, each containing 4200 turns of No. 28 enameled magnet wire, making 8400 turns in all. The wire is wound in layers about an inch wide and separated by a double thickness of oiled paper between each two layers of wire. The paper should be 1½ inches wide. In Fig. 6 is shown the method of clamping the core leg in the lathe for winding.

Before starting the winding, a strip of thin copper ribbon is cemented to the insulation as shown in Fig. 7 to provide the connection between the two halves of the secondary. A strip of paper is placed over the ribbon and the winding started after the end of the wire has been soldered to the ribbon. When the first section of the secondary has been completed, the finishing end of the wire is soldered to a piece of ribbon, a few turns of paper taken over the final layer of wire, and the core leg removed from the lathe. The fibre shield which separates the two secondary sections is then slipped in place and the core replaced in the reverse direction; that is, the core is turned end-for-end in replacing it to make the blank portion of the core take the place of the wound section. The second half of the winding is then started by soldering the wire to the copper strip as before. Assuming that the lathe is turned always in the same direction, the act of reversing the core insures that the direction of the winding shall be continuous in both sections, with their starting ends connected together by means of the copper strip.

ASSEMBLING AND MOUNTING

The secondary finished, the two legs containing the windings may be stood on end and the remaining core strips inter-

(Continued on page 429)

Practical Electro Therapy

Edited by Thomas Stanley Curtis

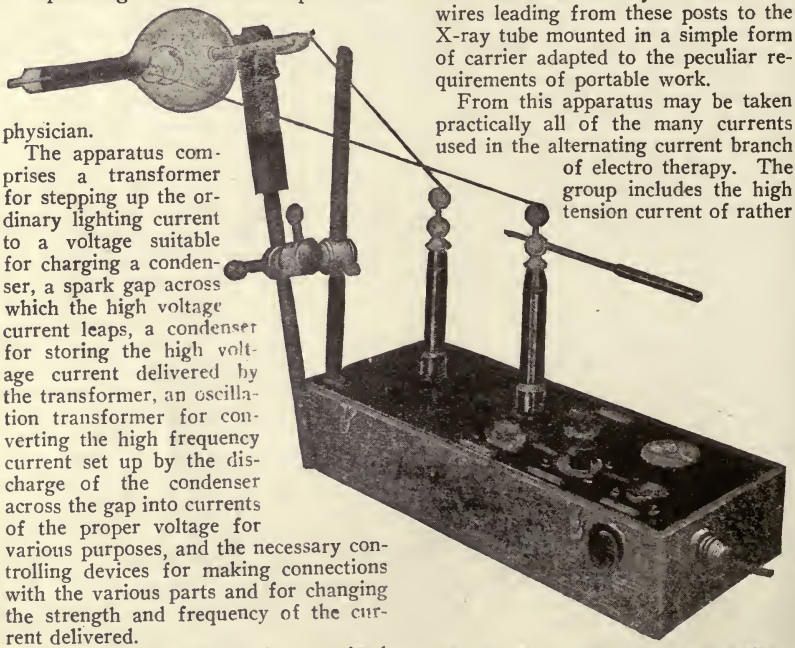
High Frequency Apparatus

IN the present article the aim will be to give a brief description of a modern high frequency outfit of the portable type. It is probable that there are more coils of this description in use than of any other form. The apparatus offers the advantage of bedside administration and it is at the same time capable of practical work in the office or operating room of the up-to-date physician.

The apparatus comprises a transformer for stepping up the ordinary lighting current to a voltage suitable for charging a condenser, a spark gap across which the high voltage current leaps, a condenser for storing the high voltage current delivered by the transformer, an oscillation transformer for converting the high frequency current set up by the discharge of the condenser across the gap into currents of the proper voltage for various purposes, and the necessary controlling devices for making connections with the various parts and for changing the strength and frequency of the current delivered.

The entire apparatus is contained within a case of oak, topped with a hard rubber cover on which the control handles are fitted. The various currents of comparatively low voltage are available through plug sockets in the hard rubber top, while the high tension current for X-ray work is taken from the terminals at the tops of the hard rubber posts which rise above the case. In the illustration may be seen the wires leading from these posts to the X-ray tube mounted in a simple form of carrier adapted to the peculiar requirements of portable work.

From this apparatus may be taken practically all of the many currents used in the alternating current branch of electro therapy. The group includes the high tension current of rather



A Portable X-Ray Outfit of Compact Design.

coarse frequency for X-ray work, high tension at very high frequency for vacuum tube treatment and the generation of ozone, medium tension at high frequency for D'Arsonval treatment in auto-condensation, low tension at high frequency for thermo-faradic effects, low tension at commercial frequency for sinusoidal effects and still lower tension for use with the cautery electrode and diagnostic lamp. In addition to the above, a hot, biting spark admirably adapted for fulgeration is obtainable, as is also the mild but penetrating current necessary for cataphoresis.

In the next article a detailed description of the component parts of this apparatus will be given and this will be followed by directions for using the apparatus to the best advantage for the various kinds of treatment.

A LIBRARY DOME IN WOOD AND GLASS

(*Continued from page* 400)

precisely the same when the assembly is finished in order that the lamp may hang properly. The leveling in the opposite direction is accomplished by the addition of small weights inside the dome.

The finish of the lamp is optional with the builder as is also the kind of wood selected. Straight-grained oak, stained to harmonize with the furnishings of the room, makes an attractive piece of work.

CONSTRUCTION OF A WELDING TRANSFORMER

(*Continued from page* 403)

the winding holds it. The same procedure is repeated with the other core leg and two layers of press board fitted ready for the secondary winding.

The secondary consists of 10 turns in all, five to each layer. The winding is composed of three No. 4 D. C. C. wires wound in multiple as shown in Fig. 8. The wire should be on three spools arranged conveniently in back of the operator who should wear canvas gloves in handling the heavy conductor. The wires will have to be tapped in place with a small wooden mallet. The starting ends are soldered to a piece of heavy copper strip, the winding done, and the finishing end secured in a similar manner. A substantial covering of press board finishes the windings after they have been liberally painted with armalac or a similar compound.

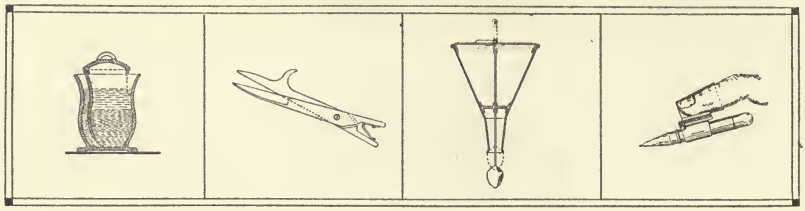
The legs with the windings on may then be set on end and the 3 by 6 inch pieces of steel interleaved in order to complete the magnetic circuit. One end of the core complete is shown in Fig. 2. A slight tapping with a light hammer will set up the irons.

THE MOUNTING

The mounting is clearly shown in Fig. 10 as is also the direction of the windings. The builder should determine this very carefully by placing the cores end to end before assembling and then noting which terminals of the windings, when connected together, will produce a continuous winding in one direction throughout.

The copper ribbon taps are soldered to No. 10 flexible stranded conductor on the primary and to three No. 4 flexible stranded cables in multiple on the secondary. The cables are led to binding posts on the primary end and massive copper bolts on the secondary. The connections between the halves of the windings are made with strips of copper insulated with tape.

The April issue of this magazine will appear under its new title, THE WORLD'S ADVANCE. Don't forget the new name when ordering your copy from the newsdealer. An announcement regarding the change of name appears on pages 289 and 430.



Recent Novel Patents

An Unique Gravy Dish

A New York inventor has patented a gravy dish of such design as to permit of pouring out fat gravy from the top of the dish or lean gravy from the bottom, at will. As shown in the accompanying illustration, which is a cross section of the dish, the device is partitioned off so that when the receptacle is tipped on one side, the gravy is drained from the bottom, while on the other side the gravy comes from the top.

Shears of New Design

Several advantages are possessed by shears made after the design of a New York inventor. The newly patented shears have blades of about the usual size as shown in the sketch; these blades being normally kept open by a powerful spring. The usual handles are dispensed with.

An Automatic Funnel

A clever idea in the way of a funnel has recently been patented by an Illinois inventor. His invention comprises a funnel that is fitted with a sliding shaft through its center, at the lower end of which is a small, wedge shaped float. The action of the funnel is this: When liquid is poured through it into a bottle or other receptacle the float will rise when the liquid reaches it and finally press against the opening in the stem of the funnel and shut off the flow of liquid. Meanwhile, an upper pivoted member, which has previously been laying in a horizontal position, is raised to an upright position and locks the float tightly in place. It also indicates that the bottle is full.

Pen and Pencil Holder

The subject of a patent recently issued to an inventor of Texas is a pen and pencil holder. This device is readily slipped over the end of a pen or pencil and is provided with a sleeve through which the index finger of the writer is passed.

A Device for Swimmers

A Maine inventor has secured patent rights on a simple attachment for swimmers. His invention is in the form of a cone-shaped fabric bag held over a metal framework and strapped to the leg of a swimmer. An attachment for each leg is necessary. The action is simple, the bag spreading out and offering a good hold on the water when the swimmer pushes his legs back, and folding up and offering practically no resistance to the forward progress when the swimmer moves his legs forward preparatory to the next stroke.

Mud Guard for Automobile Wheels

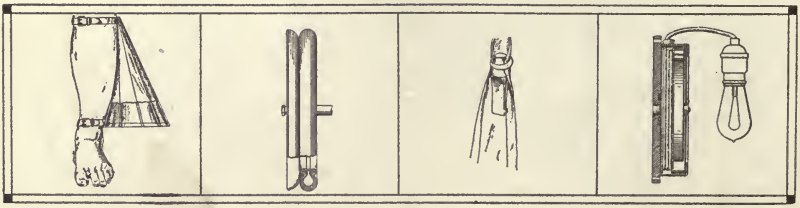
An attachment for the wheels of an automobile to prevent the splashing of mud is the object of the invention of a Rhode Island native. The attachment is in the form of a round ring of the size of the tire to which it is fastened. The ring is made of flexible material. It is said to prevent the splashing of mud which often inconveniences and aggravates pedestrians.

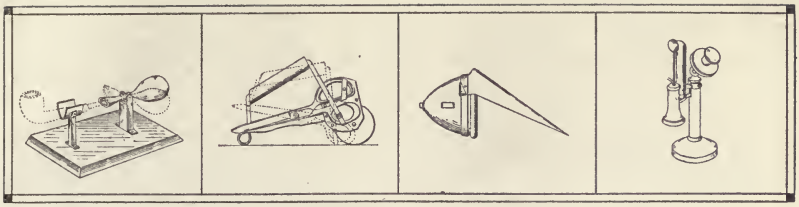
Device for Necktie

To facilitate the wearing of rings on neckties, a Maryland native has invented the simple article shown in one of the accompanying sketches. It consists of a single piece of wood or other material, tapered at one end and wedge shaped at the other. The ring to be worn is slipped down over the necktie with the device in the rear, and when it is tightly wedged, the clip member near the lower end is securely fastened to the back portion of the tie.

Handy Electric Lamp

Two Indiana inventors have jointly patented a convenient form of electric lamp and cord, the main feature of the device being that the lamp cord is always wound up on a reel by means of a spring, within a compact case when not in use. The case can be screwed on a wall and when the lamp is desired in any place, it can be carried about and the lamp cord will be fed out as fast as required.





Smoke Pipe Tester

A New York inventor has patented a smoke pipe testing arrangement which is illustrated in one of the accompanying sketches. The device is essentially comprised of a pneumatic bulb, a tapering mouthpiece for receiving the end of the pipe stem, and a suitable stand for holding the pipe. The inventor states that the device will greatly simplify the cleaning out and testing of a pipe stem and its bowl.

Attachment for Shears

A New Jersey inventor has devised a clever attachment that may be used in conjunction with any ordinary pair of shears to facilitate the cutting of goods. His attachment, illustrated in one of the accompanying sketches, when moved along by the handle causes the blades of the scissors to open and close. With this attachment a great saving in time can be effected when cutting fabrics.

Automobile Lamp Attachment

What appears to be a simple plan for eliminating the dangerous glare of automobile lamps is presented in the invention of a Westerner. As shown in one of the accompanying sketches, his invention consists of a simple hood attachment that is placed in front of an automobile head-light. The attachment is so designed that it permits the rays of light to be cast downward, yet shields them from glaring into the eyes of autoists coming in the opposite direction.

A Telephone Attachment

An inventor of Philadelphia has secured patent rights on a novel attachment for desk telephone instruments. As shown in the accompanying illustration, the attachment is in the form of a tube that is clamped to the stand and which contains a weight that is attached to the telephone receiver by means of a flexible cord. The inventor claims that this device facilitates replacing the receiver on the hook arm. The invention suggests another device that would prove very useful. Inasmuch as the cord of the receiver usually becomes twisted, an attachment might be devised that would automatically roll up the cord upon replacing the receiver on the hook arm.

Boat Propelling Mechanism

A simple paddle action for propelling boats is the subject of a patent granted recently to a Georgian inventor. By a chain drive from a gasoline engine or other suitable source of power, two paddles are alternately operated so as to give the boat a constant, forward movement.

Attachment for Pens and Pencils

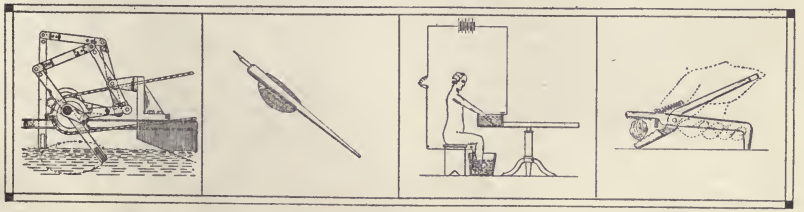
A Chicago inventor has recently patented a device for use with any pen or pencil. His invention is illustrated in one of the accompanying sketches, and it will be noted that it is in the form of a grip for the fingers of a writer. The shape of the device, combined with a weight placed in the lower portion of it, is claimed to make handwriting an easier task and far less tiring.

Extracting Metals from Human Bodies

An Englishman has secured American patent rights on a simple method of extracting metals from the human body. His plan is to have a patient place both hands in a conducting liquid contained in a suitable receptacle, and both feet in another receptacle filled with conducting liquid; electrical connection being thus established through the body. It is stated that certain metals in the body will thus be extracted and deposited on the electrode placed in the foot bath. Such a system would probably be of great aid in treating lead or copper poisoning.

An Improved Nut Cracker

A Pennsylvania inventor has secured a patent on a nut cracker of modified design. In order to facilitate the cracking of nuts, he has provided his device with a bent handle that serves to rest the cracker on the table so as to secure greater pressure. The ridges in the jaws have also been designed to give greater efficiency. One unique feature of the device is a spring for automatically opening the jaws after pressure has been removed from the handles. Another is presented in a set screw which limits the distance to which the jaws may close. Not only does the latter feature prevent the nuts from being badly smashed, as is often the case with the conventional designs of nut crackers, but it also eliminates the possibility of bruising the hand of the user should it be carelessly placed between the handles.



Questions and Answers

This department will appear regularly in MODERN MECHANICS, subject to the following regulations: The questions must be legibly written with typewriter or in ink, on one side of the sheet. Each question must be definite and cover but one point of the subject under consideration, although a letter can contain more than one question. On the 10th of the second month preceding the date of issue of the magazine, all the questions on hand will be considered and those which are put in the most intelligent manner and of widest general interest will be selected for publication in such issue, the number being governed by the space available. All other questions will be returned to the writers with a statement of the price for which they will be answered by letter. Return postage must be enclosed with each letter containing questions, and the letters must be addressed to the Questions and Answers Department and contain nothing relative to other departments of the magazine.

ROTARY GAP.

(15) H. W. M., Unalaska, Alaska, writes:

Q. 1.—Can you suggest any means whereby I can use a closed core transformer on a 135-volt storage battery circuit?

A. 1.—It is rather unsatisfactory to try to use a closed core transformer on interrupted direct current. If you had an electric interrupter at your disposal in which you could vary the number of interruptions per minute, you might try it with the transformer and see if your results would warrant its permanent use. We doubt if the results would be very successful.

Q. 2.—At what speed will I have to run a 32-point disk to get the tone of a 250-cycle generator?

A. 2.—950 R.P.M.

ALTERNATING CURRENT MOTOR.

(16) T. P., Hamilton, Ont., asks:

Q. 1.—In making the alternating current motor described by Leeth in the July magazine what sized wire should be used on the armature?

A. 1.—Almost any size will answer, the larger the better. The ends are merely attached together on a short-circuit, for magnetizing effect is a matter of ampere-turns. Large wire will give fewer turns but more amperes than fine wire, but the product of the turns and amperes will be about the same.

Q. 2.—What causes the armature to revolve?

A. 2.—A complete explanation of the operation of a single phase induction motor is long and abstruse. In general, the motor is not self-starting. Only as special devices are employed is it enabled to make even a feeble start. As long as the armature is stationary it is merely a short-circuited transformer secondary. When started by hand or any other means, additional currents are induced in the armature by virtue of the dynamo action. The resultant field magnetism set up by these two currents produces a pulsating effect that somewhat resembles a two-phase motor. The explanation of the operation of two-phase and three-phase motors is readily found in most books on electrical engineering.

Q. 3.—How are the two field spools to be connected in "multiple"?

A. 3.—Each is to be an independent path for the supply currents. Ignore the existence of one of the coils, and connect the other to the supply mains. Now connect the ends of the second coil to the same points to which the first is already connected. The connection should be made in such a manner that the currents will flow in opposite directions around the two coils. This you can check by merely following the course of the winding, or testing the polarities with a magnet or compass, direct current being applied during the test, say from one or two dry cells.

INDUCTION ON BELL WIRES.

(17) E. A. D., Longport, N. Y., writes:

Q. 1.—After I send with my wireless set I notice that the electric bell starts to ring and will continue sometimes for as long as ten minutes, then stop. The trouble is removed when I ground one wire of the bell circuit. I use a ¼-kw. transformer. What causes the bell to ring, then stop?

A. 1.—The induction from the wireless set causes high voltage currents to be set up in the bell wiring. The insulation on these wires is not capable of standing such a high voltage and the result is that at some place where the two bell wires come together the insulation is charred off and a poor short circuit forms. After the bell has rung for a few minutes the bell batteries are somewhat run down and as the short circuit is not a good one there is not enough power to maintain it and the bell stops ringing. When you next start sending the high voltage induced in the wires again closes the short circuit and the bell will ring for another period. Grounding the wire stops this induced voltage in the closed circuit and there is no spark to start a short circuit.

Q. 2.—I always understood that the more ground connection you used the better. I have connected a wire fence to my regular ground

and instead of improving the signals it actually weakens them.

A. 2.—The wire fence in itself is probably not well grounded and acts as a capacity ground connected direct to a metallic or earth ground and therefore as a grounded aerial in the vicinity of your regular aerial. In general, your proposition of the more ground the better is correct.

REWINDING A MOTOR.

(18) K. H. R., Oakland, Cal., asks:

Q. 1.—What changes should be made in a 1-h.p., 500-volt motor to adapt it for use as a 50-volt generator? Machine has four field poles, each wound with No. 30 d.c.c. wire. Armature has 32 slots and is wound with No. 23 wire, but commutator has 93 segments.

A. 1.—At present the four field coils are of course connected in series, but if you were to use the machine for 100 volts you could merely connect them in parallel and thereby not have to rewind them. If you desire to use the present wire, though admitting the necessity of rewinding it, you could wind two wires in parallel and finally connect the four spools in parallel with each other. If you prefer new wire and to put the four in series, use No. 21. This larger size will wind more economically than the other, so you will be able to get 10 per cent. more weight in place. The armature is evidently series wound, there being the full 32 sets of coils, three coils per slot, but one of them is left disconnected, it merely filling the space, and the remaining 31 sets furnish 93 coils and connect to the 93 segments. For your low voltage case you should seek to use the multiple winding with 32 complete sets of coils and an even number of commutator segments. By judicious soldering at the places where the winding connects you can bunch the segments in twos and threes, thereby getting the effect of 32 distinct groups. Still, the segments are so thin as to promise difficulty in soldering in the regular windings. If only you could insert three more segments you could wind the armature coils with three wires in parallel, and have groups of three segments of the same potential. The simplest method will be to get a 32-segment commutator and wind the armature anew with 32 coils, each consisting of No. 17 wire. The machine will be good for 20 amperes.

A. C. MOTOR ON D. C.

(19) A. R. B., San Leandro, Cal, asks:

Q. 1.—Will the alternating current motor described on page 79 of the July, 1914, magazine operate on direct currents?

A. 1.—Not as there described, but if you connect the ends of the armature winding to a 2-segment commutator, and apply brushes at the right position, it will run, but will not be suitable for a voltage much above 25.

Q. 2.—What size of wire should be put on rotor?

A. 2.—For the alternating current use it will make but little difference—its ends being merely connected together on a short-circuit. The intention was to use the same size as on the field magnet, *i. e.*, No. 18. For direct current working perhaps No. 20 would be better. For the alternating current case as described, wind 20 turns on one side of shaft and connect the ends together. Then wind a similar coil on other side and connect its ends together. Be sure you recognize that an "induction" motor was described, and in such a case it is not necessary that the rotor should have any external electrical connection.

GENERATOR WINDINGS.

(20) G. W. C., Hamilton, Ont., asks:

Q. 1.—What should be the proper winding for a bipolar dynamo having a field bore 3 1/16" in diameter and 2¼" long axially, with a 12 slot armature?

A. 1.—You will find excellent drawings and descriptions of a dynamo of almost these dimensions in Watson's "How to Make a ¼ Horse-Power Dynamo," published by the Bubier Publishing Co., Lynn, Mass. You should make the pole tips a little closer together than you have shown in sketch, and have no such extent of waste room between field spools and pole tips. Perhaps you intend to make the field in one piece. This is an attractive feature, but leads to inconvenient constructions in other points, or else reduces the possible output. You should be able to get 200 watts out of such an armature.

ARMATURE WINDING.

(21) C. F. H., Spokane, Wash., asks:

Q. 1.—What should be the armature winding for an existing 110-volt shunt motor for changing it into a 6-volt generator, field magnet being retained as it is to permit operation separately excited? It has ring armature, 4½" in diameter, 2½" wide.

A. 1.—As you give no idea of the present size of wire nor dimensions of the field magnet, we are helpless to make an explicit reply. In general you ought to be able to use present commutator, but using larger wire with fewer turns per coil. Probably the armature is of the smooth-core type, and we should judge that a single layer of No. 12 magnet wire would suffice. With more explicit information we could furnish a more precise answer.

It is not possible for this department to answer questions by mail. Persons wishing prompt answers by mail should send the regular fee of fifty cents to cover the cost of the work. If this is not sufficient, they will be advised as to the additional cost. This service is only offered to readers and the price charged often does not compensate for the time involved.

RADIO SECTION

Devoted to the Encouragement of Amateurs and Experimenters in the Field of Radio Communication.

SOLVING THE AMATEUR'S DIFFICULTIES*

Helpful Information Tending to a Better Understanding of the Radio Law and Increased Efficiency of Apparatus.

By E. E. Bucher
Instructing Engineer, Marconi Wireless Telegraph Company of America.

LACK of understanding has, in many instances, not only placed the amateur radio-experimenter in an unsettled state of mind in regard to the requirements necessary for compliance with the United States radio laws, but it has also prevented the full realization of the benefits he should derive from his equipment.

AERIALS AND THE LAW

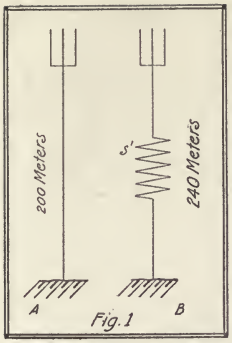
Hundreds of times the writer has been confronted with the question: "What are the proper dimensions for an aerial to have a wave-length of 200 meters in accordance with the United States regulations?" This query alone betrays a misunderstanding of the underlying principles and for that reason a few words of explanation may not be amiss. The proper answer is: To conform to the Government regulations you do not require an aerial having a natural wave-length of 200 meters, provided you intend employing an oscillation transformer to transfer energy to the aerial circuit.

It should be clear that if the aerial shown in Fig. 1 at *A* has a natural wave-length of 200 meters, and the secondary winding of the oscillation transformer *S'* is then connected in series, as shown at *B*, the emitted wave due to the added value of inductance will be considerably above 200 meters, immediately placing this station under the ban of the radio regulations. Since it is not good practice to insert a series condenser to reduce the wave-length of the antenna to 200 meters, the only remaining alternative is to so proportion the antenna at the start that when the secondary winding of the oscillation transformer is added, the wave-length of the antenna circuit will be near to a value of 200 meters.

This is by far the method to be preferred, but it often elicits disgust from the amateur when he compares his law-abiding transmitting aerial with the one he possessed before the Government authorities took a hand in the matter.

It may be well to announce here that the writer has been reliably informed that amateur stations located within the zone of interference—that is to say, so located that they may possibly interfere with the carrying on of commercial business—are expected to meet the requirements demanded from the regular com-

* This is the first part of this excellent article by Mr. Bucher. The second and concluding part, dealing with oscillation transformers, receiving tuners and other problems of the average wireless amateur, will appear in the April issue.



Wave Length of an Aerial With and Without Oscillation Transformer.

mercial stations in respect to the character and decrement of the emitted wave; while on the other hand, amateur stations located outside the zone of interference, may, upon satisfactory evidence to the Radio Inspector, be allowed to operate their equipments when the emitted wave does not fully comply with the law. Interpreted more plainly, this means that amateur transmitting stations within the zone of interference must use an oscillation transformer having a variable degree of coupling so that the least possible degree of interference is produced, whereas those stations outside the zone of interference may simply connect the spark gaps of their induction coils in series with the antenna, that is to say, use the plain aerial connection. This latter statement, however, applies more particularly to stations which were in operation when the law took effect. New stations should endeavor to meet all conditions regardless of their location.

The amateur employing an oscillation transformer must have an antenna the wavelength of which is considerably less than 200 meters, while one who is using the "plain aerial" connection should erect an aerial having a natural wave-length of 200 meters.

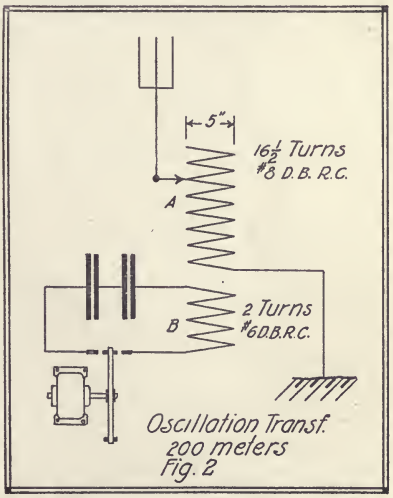
In order that an amateur's apparatus may comply with the law, data as to the proper dimensions of a 200-meter aerial may be of value. An aerial consisting of four No. 14 wires spaced two feet apart and having a height of 40 feet, with a flat top portion 50 feet in length, will have a natural wave-length very close to 160 meters. Dimensions of other aerials giving approximately the same wave-lengths are as follows:

Vertical Height.	*Flat Top Length.*
32 feet	60 feet
20 "	70 "

It is not expected that the amateurs in all sections of the country will be able to so place their aerials as to comply specifically with the foregoing-mentioned dimensions, but the measurements given may be referred to for guidance.

Supposing it is desired to raise the wave-length of an aerial from 160 to 200 meters by a coil of inductance which is to constitute the secondary winding of an oscillation transformer. It may be built in the following manner: A mandrel or any insulating support 5 inches in diameter is wound closely with 16½ turns of No. 8 D. B. R. C. wire. When this inductance is placed in series with the aerial of 160 meters as shown in Fig. 2, the wave-length of the circuit will be raised to 200 meters.

It should be thoroughly understood that the inductance coil may be used as the secondary winding of the oscillation transformer, being placed in inductive relation to primary winding *B* as in Fig. 2. The dimensions of the latter winding, *B*, will, of course, depend



Connections for an Oscillation Transformer, Condenser and Rotary Gap.

upon the value of condenser capacity in use, but as a rule it may consist of one or two turns of, say, No. 6 D. B. R. C. wire. To obtain radiation these turns are not necessarily wound tightly over the secondary turns. It will probably be found that in order to comply with the law, they may have to be placed a few inches from the secondary winding.

The amateur whose station is so situated that he is allowed to connect the spark gap directly in series with the antenna (plain aerial connection) may erect an aerial having a natural wave-length directly at 200 meters. Dimensions for such aerials are tabulated as follows:

Vertical Height.	*Flat Top Length.*
35 feet	75 feet
30 "	80 "
50 "	60 "

These dimensions are based on an aerial composed of four wires spaced two feet apart.

The writer's attention has frequently been called to the fact that many amateurs erect aerials of "freakish" design. This is generally due to the lack of space, but in many cases the antennæ are so constructed with the thought that greater radiation thereby results. The "zig-zag" type of aerial may be mentioned in this respect. It is believed that a great increase in wave-length is obtained. True enough, the wave-length of the aerial is slightly increased by "zig-zagging" due to an increase in capacity, but the inductance of such an aerial, due to the "doubling back" of the wires, is decreased and the desired improvement is only partially experienced.

Transmitting aerials should be symmetrical in design and possess uniformity of construction throughout. This seemingly is not such an important factor in receiving aerials as in transmitting aerials. It may be of interest to the amateur field to know that it has been pretty well proven through experiment that a long, narrow aerial of standard construction is far superior to that type which, in the language of certain amateurs, is "spread over an acre lot."

TRANSMITTING CONDENSERS

A problem which presents much confusion to the amateur is the proper size for a condenser for a 200-meter transmitter. It may be said that the maximum capacity that can be used in the closed oscillatory circuit of the transmitting set is 0.01 Mfds. Even with a capacity of this value, the primary inductance coil of the oscillation transformer previously described need not possess more than one or one and a half turns, which will be quite sufficient for the transfer of energy. A condenser having this value of capacity may be readily constructed in the following manner: A plate of glass ⅛-inch in thickness and with other dimensions of 14 inches by 14 inches, covered on both sides with tinfoil having dimensions of 1 inch by 12 inches, will have a capacity value of approximately 0.002 Mfds. Five of such plates connected in parallel will give the desired resultant capacity for 200 meters. If, in order to eliminate all fear of puncture due to excessive voltage, series parallel connections are to be used, twenty plates will be required —ten in parallel in each bank and the two banks connected in series. This connection will reduce the strain on the plates by one-half. Or if desired a condenser possessing the same capacity can be used instead, the dimensions being: Twenty-four or twenty-five plates of glass, 8 inches by 8 inches, covered with tinfoil 6 inches by 6 inches. When these plates are connected in parallel, the resultant capacity will be the same as the condenser decrement above, 0.01 Mfds. The size of the transformer required for this condenser will depend entirely upon the frequency and potential of the transformer and unless definite knowledge in this respect is given, no advice can be offered. However, this one example may be of help: If the transformer secondary potential is 15,000 volts and the set is employed in connection with a rotary gap having twelve points equally spaced and rotating at a speed of 3,000 R. P. M., the outfit will consume about ¾ K. W.

ROTARY GAPS

The amateur experimenter often ignores the fact that there is considerable difference between the number of inter-

ruptions of the closed oscillatory circuit produced by the rotary gap and the corresponding tone or note. He is unaware that the quality of the note depends to some extent upon the distance between the moving electrodes (on the disc) as well as the speed of the disc.

The writer once visited a certain amateur station employing a disc discharger which had 20 points on a disc 4 inches in diameter revolving at a speed of 3,000 R. P. M. Upon testing the gap the amateur was surprised to find that the note was not musical. The facts were that the moving electrodes passed the stationary electrodes so rapidly that a practically continuous spark discharge surface was presented, giving the gap no time to clear itself between the interruptions. The resultant note was no different than that obtained with the plain two-electrode stationary gap. As a remedy, the writer suggested either a larger disc with the same number of points or the same disc with a reduced number of points. Both methods were tried and a more musical note was produced.

For amateur use in connection with a ½ K. W. set, the writer suggests a rotary disc with the following dimensions: The disc should be made of black hard fibre or of Bakelite, ¼-inch in thickness and 8 inches in diameter. The disc should be fitted with eight electrodes of brass 3/16-inch in diameter. The electrodes should be slightly rounded at the tips, and placed through the disc and firmly fastened with nuts and washers. The electrodes must be of absolutely uniform length and all should project a uniform distance. The stationary electrodes should be of similar diameter, but may be fitted with cooling vanes. The disc should then be mounted on a D. C. motor having a normal speed of 2,400 R. P. M., but capable of adjustment from 2,000 to 3,000 R. P. M. For speeds below 2,400 R. P. M., a series resistance is connected in the line to the motor. For speeds above 2,400 R. P. M., a resistance coil is connected in series with the field coils of the motor. The latter resistance may consist of 16 C. P., 110-volt lamps used in parallel or in series parallel, depending upon the design of the motor.

When selecting a disc for a rotary spark gap the amateur had better assure himself that the material will stand the peripheral speed required. If in doubt, the disc had better be mounted on a high speed motor and tested at a speed somewhat in excess of that at which it is to be used, making sure to stand at a distance during the test. The writer recently witnessed a purchased rotary gap of popular make collapse at a speed of 3,400 R. P. M. The flying spark electrodes cut gashes ¾-inch in depth in hard wood and other particles wrecked a heavy plate glass window!

Where rotary gaps of the non-synchronous type are employed there should always be some means at hand for controlling the secondary voltage of the transformer, for it is invariably found that a clear note is a result of the voltage adjustment, as well as of the speed of the disc. It may also be added that in changing from a fixed spark gap to one of the rotary type the existing condenser capacity, if it was of the proper value in the first place, must invariably be reduced.

Owing to the differences in wave form of generators and transformers, also the different values of secondary voltage found in the amateur transformer, the proper condenser capacity is best determined by experiment, but in any case for a 200-meter wave it must be at least below 0.01 Mfds.

SHOCKS BY WIRELESS

At Clichy-Levallois, a suburb of Paris, some electricians received severe shocks from touching a large mass of stored telegraph-wires not connected with any system. An investigation showed that the shocks were caused by Hertzian waves sent out from the great wireless station on the Eiffel Tower, a few miles distant. By a curious accident the group of wires happened to present all the conditions of height, distance and position essential to receiving communications from the Eiffel station.

A New System of Radio Communication

By Robert G. Skerrett

FOR years the world generally looked upon Peter Cooper Hewitt's mercury-vapor lamp as the climax of the mercury-vapor arc's usefulness. But Dr. Hewitt has a restless scientific mind, and he dreamed of other applications of wide practical value. He was convinced that there were many things going on within the glowing vacuum of his lamp beside the electric current colliding with minute particles of floating mercury. And so, for sixteen years he has been patiently watching and studying this arc, and now he is ready to give to the world an entirely new development for radio communication.

Indeed, he not only promises to advance the art by tremendous strides but he reasonably assured us that wireless telephony over long distances will be within the financial reach of all of us. Let Dr. Hewitt tell the story of his remarkable invention in his own way:

"I have found that there are nearly forty different things going on inside the tube of a mercury-vapor arc, but in the beginning I thought there were scarcely more than three. It was not long after I had perfected the mercury-vapor lamp that I discovered a strikingly peculiar characteristic. In an ordinary incandescent bulb, if an alternating current be used, the current still remains alternating after passing through the filament and continuing along its path in the circuit. Now, when alternating current is fed to a mercury-vapor lamp it comes out at the opposite terminal in the form of a continuous or direct current. In other words, it is completely transformed. I wondered at this and tried to discover the reason for it. In working away at this puzzle I identified the numerous phenomena that are part of the active life of the mercury-vapor lamp. Latterly I have learned how I can make use of certain of these electrical characteristics.

"Hertzian waves are vibrations of the universal ether, and when these undulations are given sufficient energy or impulse they will travel long distances. The familiar simile of the continually-widening ripples from a stone dropped into still water is sufficiently accurate for ordinary purposes. If the original disturbance be not great enough the spreading wave-rings will diminish gradually and finally disappear before going far. Oppositely, a violent agitation of the water will produce bigger waves and stronger ones, and these will travel farther before dying out. Let us illustrate the practical application of this theory that we may see the function my apparatus will perform.

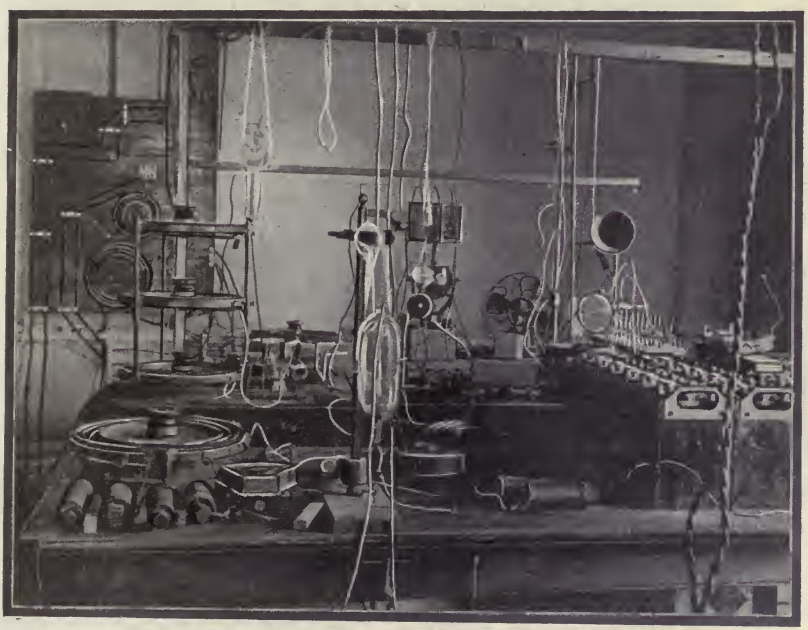
"There are in service to-day two kinds of oscillators for the production of Hertzian waves for radio communication. One, which generates a rapid series of powerful sparks at the gap of an electric circuit, is the means by which long and short wave-trains, representing the dashes and dots of a telegraphic code, are sent out through space; and the other causes a continual agitation of the ether—the dots and dashes being represented by breaks occasioned through the changing of the wave-length. That is, the receiving apparatus is tuned let us say to a wave-length of 4,100 meters and is insensitive to arriving wave-lengths 200 meters shorter. The sending operator merely works a key so as to effect this variation in the constant stream of undulations. This system was invented by Waldemar Poulsen of Denmark.

"The spark-gap oscillators are costly affairs; the big rotor for this work weighing five tons in one of the trans-Atlantic plants. It is built wellnigh as carefully as a watch and, to carry the comparison further, is pretty nearly as delicate. Constant heavy work is apt to derange it. Mechanically, the Poulsen arc is much simpler, but the difficulty lies in the fact that the carbons between which the flame is made burn out rather quickly and are expensive to replace.

Nevertheless, it is the oscillator that produces continuous waves that is most efficient. How is this?

"Returning to the simile of the water ripples, if you keep up an unceasing agitation, as with a stick, without increasing the energy employed, the little waves that otherwise would soon die out if you moved the stick once will, when you keep it in motion, cause these waves to spread and spread until they reach the other side of a good-sized pond. In wireless, the difficulty, as I have just said, lies in the producing of continuous undulations even though theoretically the thing desired. I have found out that I can get from a mercury-vapor-arc oscillator, weighing not more than two pounds, an uninterrupted flow of Hertzian waves that will reach as far as those generated by the sparking machine in which the rotor weighs quite 10,000 pounds!

"Conversely, my mercury-vapor-arc receiver will pick up any Hertzian wave, be it long or short; and in these two apparatuses I have the essentials of a successful long-distance system of wireless telephony. As you know, the telephone must be responsive to wide variations of wave-lengths or vibrations, because in common speech the different vowels and consonants vary widely in this particular. Here is where the wireless telephone and the wireless telegraph are quite unlike. My experiments have shown that my receiver will respond to any sound wave and will be equally acute to waves of such frequency that they are beyond the scope of audibility. The wonderful part of the receiver is its astonishing ruggedness, for while this form of mercury-vapor arc is exquisitely sensitive to the least ether impulse, it can withstand the shock of the current from a discharge of lightning! This



Experimental Wireless Station of Dr. Peter Cooper Hewitt in which the Mercury-Vapor Arc is Employed for Both Transmitting and Receiving Purposes.

is the natural evolution of my rectifier which changes alternating current into direct current."

An X-ray tube when working gives forth a hissing sound, and a mercury-vapor arc ordinarily does the same thing. When he first tried to adapt this apparatus to wireless, Dr. Hewitt found that his telephone receiver roared like a great conch shell. All that his ear heard was a confused din. His problem was to silence this racket, and it took him a long time and called for many experiments before success was won. The little globe in Dr. Hewitt's laboratory is not more than a foot long, and looking into it one can see the glow flutter in exact unison with the long and short sounds coming through the telephone ear-piece and representing wireless telegraph signals. By sliding a little bridge along a series of contacts, the song of the wireless alters in pitch, and this change of key really indicates the signals from a different station. In some cases, the tone is deep like the whir of a humming bird's wings or, again, as shrill as the buzz of a gnat. The point is, that by shifting his receiver key, Dr. Hewitt can shut out all signals but those of the particular station he desires to hear. This is just how he will be able to insure privacy in the working of his wireless telephone, and the range of receptivity, because of the astonishing adaptability of the mercury-vapor arc, will include the gamut described in the preceding paragraph. In short, because of its remarkable flexibility, so to speak, the mercury-vapor arc plays the part of the ordinary detector.

In order to make a conversation secret, the keynote of the sending apparatus or mercury-vapor-arc oscillator, and the resonance of the Hewitt receiving arc are attuned, and this can be accomplished by using wave-lengths higher in frequency than those of any existing commercial wireless telegraph system. In fact, Dr. Hewitt will purposely employ waves ordinarily of the inaudible class because of their greater vibratory speed. Just the same, the person speaking into the transmitter would unconsciously qualify these waves so that they would reproduce the voice after these delicately shaded impuses had been caught by the wonderfully sensitive receiving arc and amplified thereby. Understand, of course, the mercury-arc receiver is linked into the local circuit of the receiving telephone, and the effect is virtually that of controlling a relay. Because of its power to amplify the effects of the arriving waves, the Hewitt apparatus gives all of the impulse shading in the local circuit or relay needful to reproduce the sender's voice distinctly even though coming from afar. Again, the speech of the sender is made to impress itself upon the wave-forms sent abroad by means of the mercury-arc oscillator, and these identities, so to speak, travel through space, undeformed, and awaken corresponding responses in the receiver distantly removed.

Dr. Hewitt proposes that the sound signals received by his mercury-vapor arc shall be reproduced on a tape in the form of dots and dashes; in fact, he has actually done this already, and thus code messages may be preserved and deciphered at leisure. Waldemar Poulsen gave us the telephonograph, which records, in the form of magnetic charges, vocal records upon a steel wire, which can be reproduced at will. For commercial service, in connection with his own invention, Dr. Hewitt would utilize the Danish apparatus to preserve long-distance-wireless telephone conversation as well as the signals of Hertzian wave telegraphy.

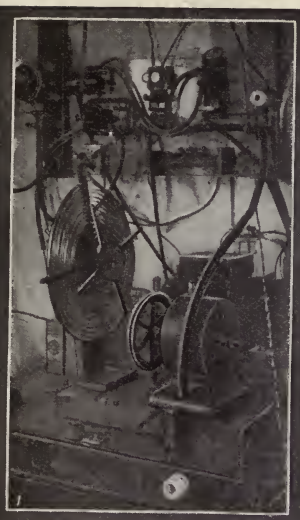
RESTORING THE SENSITIVENESS OF A GALENA DETECTOR

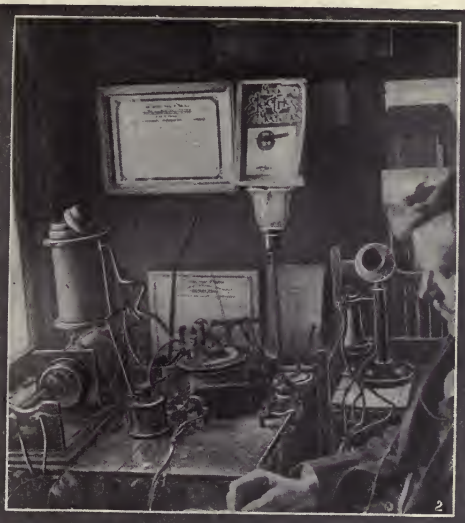
The most sensitive piece of galena employed in a detector after it has been in use some length of time is found to have lost its sensitivity, or, to use the parlance of the operators, "has gone dead." In the following is described a simple method that will enable almost any galena detector to be continually maintained at its maximum sensitivity.

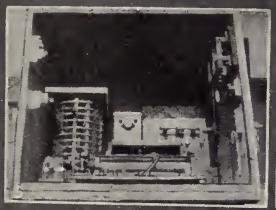
As a rule, mandolin or violin string

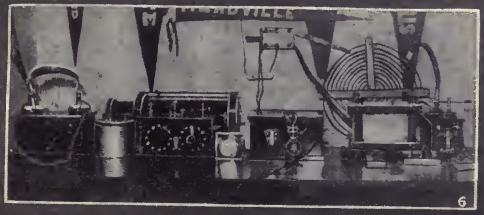
(*Continued over leaf*)

AMATEUR WIRELESS STATIONS









THE STATIONS AND APPARATUS IN THE ABOVE VIEWS ARE AS FOLLOWS:

(1)—(2)—Transmitting and receiving outfit of Jacob Weiss of Port Washington, L. I. (3)—Wireless station of Robert Hornibrook, Marinette, Wis. (4)—Transmitting and receiving outfit of Wesley J. Jameson, Jr., St. Paul, Minn. (5)—Portable wireless outfit of Francis X. Murphy, Gloucester, Mass. (6)—Elaborate wireless station of Vincent Brown of Meadville, Pa.

is used for making contact with the galena crystal. The operator usually places the wire in the holder and considers this part of the work completed and devoid of further attention. When the detector has lost its sensitivity to an appreciable degree, the operator immediately sets to work with a brush, soap and water, and proceeds to scrub the mineral, while all along the cause of the trouble is not with that member of the detector.

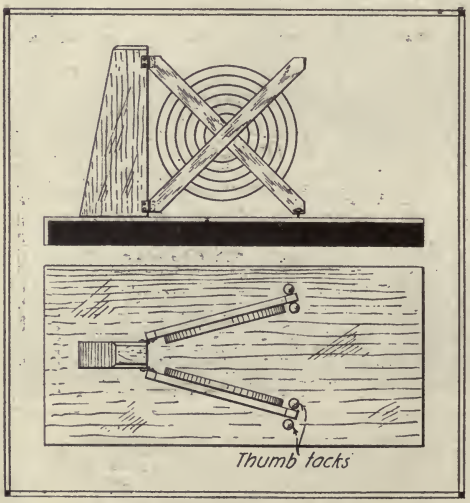
Instead of a mandolin string, which is usually hardened steel, the operator should procure a short length of stranded picture cord and pull out one of the strands which are usually of about No. 30 size. The wire is then cut at one end with a pair of scissors at a sharp angle so as to form a good point. This wire is then used in the detector; the operator finding that the efficiency of the detector is as great as ever.

The sensitivity of the galena detector can be maintained at its maximum by clipping off the end of the wire each day. Close examination of the end of the wire will indicate that it becomes tarnished in a short period of time and this has the effect of lowering the efficiency of the detector.—PAUL OARD.

INCREASING THE EFFICIENCY OF "PANCAKE" OSCILLATION TRANSFORMERS

As a result of several months' experimenting with "pancake" type oscillation transformers, the writer has arrived at the conclusion that sharper tuning and a closer positioning of the spirals can be attained if the coils are arranged in such a manner as to have the lines of force cut diagonally.

The scheme used by the author is very simple, as will be seen by the sketch. Both coils are mounted on cross pieces as shown and hinged to a wooden upright. After the spirals have been adjusted for the best results, nails or wooden pegs are driven into the wood as indicated to keep the coils in permanent adjustment.—WILLIAM H. SCHEER, JR.

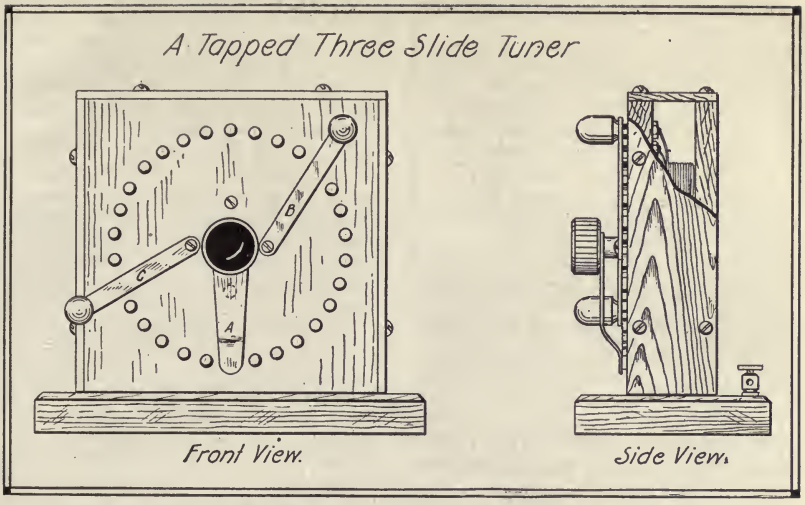


Scheme for Securing Greater Efficiency from a Pancake Type Oscillation Transformer.

A CORRECTION

Through an error the wireless station of Mr. Joseph G. Telmosse, Shawinigan Falls, Quebec, Canada, has been credited to Mr. Alfred Meuler of Oconomowoc. Wis. The view of Mr. Telmosse's station appeared on page 133 of the January issue, picture No. 2.

Don't fail to read the important announcement that appears on page 289 of this issue. It tells of the change of title as well as other facts of interest to readers. The next issue of this magazine will appear under the new title THE WORLD'S ADVANCE.



Front and Side Views of a Tapped Three-Slide Tuner as it Appears When Completed.

A TAPPED THREE-SLIDE TUNER

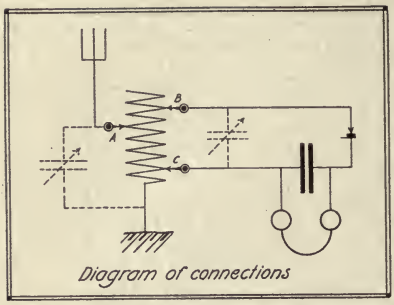
THE three-slide tuner has fallen into more or less disuse despite its many advantages, this being due to a great extent to the fact that amateurs have a keen dislike for any instruments employing sliders.

To overcome this objection, the writer has evolved a tapped tuner that retains all the advantages of the regular slider type, yet permits of greater ease in adjustment, as well as extreme compactness.

The tuner is mounted on a base measuring 6 by 8 inches, the edges being beveled to add to the appearance of the instrument. The front and back pieces measure 6 by 6 by ½ inch. The front piece is cut and drilled for 30 contact points mounted as shown in the illustration. These points are equally spaced around the circumference of a circle of 5-inch diameter. Holes are also provided for the three levers.

The foregoing accomplished, the levers are mounted in position, as shown. A knob is used on the center lever so that it can be readily turned to any desired contact, while other knobs are placed at the ends of the other two levers to facilitate adjustment. The levers are fastened at the back with nuts, these being placed in countersunk holes and connected to suitable leads. The leads are placed in slots.

The next step after mounting the switch points and levers in place is to turn a three-inch disc from ¾-inch stock. This disk is fastened between the front and back pieces by means of two long brass screws which also serve to hold the tuner together. The disk is then wound with No. 24 s. c. c. wire, the winding being as uneven as possible in order to eliminate any undesirable inductive effects which are usually encountered in layer wound tuners. A tap is taken at every eighth turn, this being found ample for comparatively close tuning. The



Wiring Diagram for the Tapped Three-Slide Tuner.

leads from the taps are brought to the contact points in proper sequence. It is advisable to solder all connections carefully in order that no loose contacts will arise later. The beginning of the winding should be attached to the contact point nearest the base.

The coil is then mounted on the base and the three leads from the levers are connected to three of the four binding posts that are placed in a row on the back of the base, while the remaining post is connected to the free end of the winding.

Thin pieces of wood may be placed at the top and sides of the tuner in order to give it a neater appearance.

In operation, the middle lever will slide over the other two levers which can be turned but a trifle more than half way. The tuner is connected into a circuit as shown in the wiring diagram, the different levers of the tuner being lettered to correspond to the sketch of the instrument.

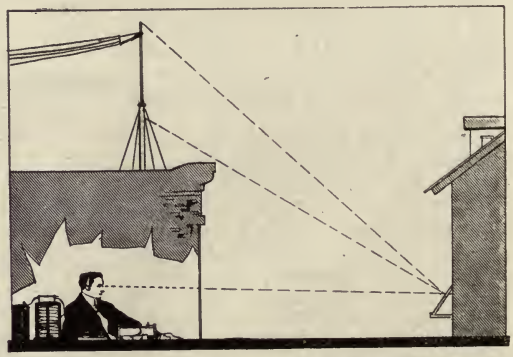
This compact tuner has a wave-length sufficiently great to hear amateurs, steamers, and most commercial stations. The signals will usually come in louder than with a loose coupler, although the selectivity is not quite as great. The additional variable condensers will, of course, lengthen the wave-length of the windings, as well as facilitate closer tuning.—THOMAS W. BENSON.

AN AERIAL SUGGESTION

Most amateurs in cities desire to keep a constant watch on their aerials in order to ascertain at any moment whether their aerial is in proper condition. Furthermore, it is often necessary to keep watch over an aerial to prevent its removal.

It is very inconvenient for anyone to be obliged to climb several flights of stairs to the roof in order to inspect an aerial. If the aerial is in front of the roof and cannot be seen from a window of the house, the following suggestion may probably be applied to good advantage:

Secure a mirror measuring about 1 x 2 feet and. after securing permission from neighbors on the opposite side of the street, erect the mirror in such a manner that it will enable a person standing at the window to secure a view of the aerial by means of the mirror's reflection. In this way it is possible to ascertain at a glance whether or not the aerial is in working order. It may also aid in catching the young wire thieves.—H. DORBE.



Without Leaving His Seat, an Amateur Operator Can See His Aerial by Means of a Simple Mirror Device.

A GIRL WIRELESS OPERATOR

ABOUT two years ago a young lady successfully applied for a position as secretary to Hiram Percy Maxim, Chairman of the American Radio Relay League. She had no knowledge of electricity and wireless, and probably no inclination for ever mastering the mysteries of either subject.

Two Views of Miss Cecil Powell and her Elaborate Receiving Set. She has Made Most of the Apparatus Herself in Order to Secure a Better Working Knowledge of the Subject.

To-day, the same young lady, Miss Cecil Powell, is an enthusiastic wireless operator and spends much of her spare time operating the wireless apparatus installed in her home. Only last October she decided to know more concerning the subject with which her work brought her into so intimate contact. She constructed in three weeks' time the greater part of her apparatus under the direction of Mr. Maxim, and thus gained a better knowledge of the subject than could have been secured through the study of books. When the apparatus was completed, she spent many a night listening to wireless signals and trying to read them. The work was slow at first, but after a while she could read a word, later, a few words and occasionally an entire sentence, and, finally, entire messages. According to Miss Powell, the learning of the code and the subsequent receiving practice was the slowest and most discouraging part of her wireless education.

When Miss Powell was recently asked whether she intended becoming a commercial wireless operator or merely had learned wireless operating as a pastime, she replied that it was only for her own amusement. She stated that it was a great source of amusement to her to listen to the conversations of others and be able to participate in them.

Miss Powell is said to be the only woman wireless operator in the state of Connecticut, the second in New England, and the fourth in the United States.

The next issue of this magazine will appear under the new title THE WORLD'S ADVANCE. There will be no alteration in the present editorial policy. Do not forget the name when ordering your copy from the newsdealer.

THERE are two extremely opposite factors that usually call for exclamations of surprise on the part of laymen being explained the mysteries of a wireless set: First, the great collection of apparatus of every conceivable description which they are led to believe is part and parcel of a wireless equipment; second, the utter simplicity of the instruments required to receive and send wireless signals through the air. And by far the admiration is greater when a simple equipment is demonstrated—and likewise the efficiency.

Simplicity—The Keynote of Efficiency

By Paul Oard

SIMPLICITY in wireless instrument construction and operation should be the keynote of every amateur's and experimenter's efforts. It seems to be the fervent desire of nine-tenths of those owning experimental stations, as soon as they have installed their sets and received a few messages, to crowd all the odds and ends they can collect on their wireless desks in an endeavor to give their station a mysterious appearance to the uninitiated.

A glance at the average amateur set will usually reveal, beside the radio set proper, an assortment about as follows: A magneto, a small shocking machine, about three extra detectors; a multitude of switches ranging from the small snap switch to the 1,500 ampere type; a telegraph sounder; a small motor, independent of the rotary gap; some "Hands off — 30,000 volts-don't-touch-me-on-pain-of-death" posters, distributed liberally around the walls; two or three coils of wire that serve no electrical purpose, and a weird collection of articles that only an experimenter can collect, from X-ray tubes to a make-and-break gas engine coil.

When the enterprising young Marconi brings in his friends, who, the chances are, couldn't tell a potentiometer from a spark plug, all this electrical display has an impressive effect upon them, and when he winds up the magneto, disturbs all the switches that he can locate, and, after putting the loose coupler through a series of gymnastics, says "Hush, here's Hong Konk talking to Moscow," they all say (and what professional operator hasn't heard this expression, as the inquisitive passengers crowd around his cabin door?) "Oh, isn't it wonderful?" When they have departed, the young hopeful muses "Funny, I can't pick up Blank, that 1 KW ought to carry at least a mile." Then begins a patient search, which, after he has unraveled all his connections and most of his temper, shows that his batteries are in dead short across his detector, and his potentiometer is on the ground circuit.

Let the experimenter thoroughly study the fundamental principles of wireless telegraphy, and in working practice resolve his set down to as little apparatus as is consistent with the best results. After settling upon his connections, the amateur should learn to use his set and not change connections until he has given the last one a thorough tryout. If this advice is followed, he will, in a short time, be obtaining from 25 to 50 per cent. better results than before. And it is well to remember that neatness goes hand in hand with efficiency. This does not mean that your apparatus must be finished in mahogany, hard rubber and silver plate, for pine, paper or fibre insulation and plain brass will do their work as well as the others, as long as proper care is exercised in the construction. Your desk need not be polished to mirror-like brightness; plain wood, finished in dead black, stands for business.

If you are an experimenter working

The Enterprising Young Marconi Brings in His Friends, Who, the Chances are, couldn't Tell a Potentiometer from a Spark Plug. All this Electrical Display has the Desired Impressive Effect Upon Them.

with the idea of finding ways and means of improving radio communication, try to have your workshop separate from your wireless set proper, and if you cannot have it in another room, at least have them on separate tables. By running leads from your main set, you can connect in your experimental set and save the trouble of disarranging your set proper.

If you are one of the many who use their wireless sets for the pleasure they can derive from it, with an aim of picking up as many stations as possible, resolve upon what you consider the best type, connect it up according to the best practice, and then learn to use it. Make your connections permanent. If your apparatus is of light construction, fasten it down to the table, so that it will not be hopping around when you adjust it.

Did you ever see a professional set with two extra detectors, each with a different mineral? Yet most amateurs have two or three extra detectors, say Galena, Silicon, Perikon, and Molybdenite. True, you will often find extra detectors on professional sets, but they are generally spares, to be used in case of breakage of the regular detector. If, in rare exceptions, another type is used, it is always of a type that is made for close work, chosen with a view toward staying powers and not toward sensitiveness. Accordingly, it is better to have one very sensitive mineral for long distance work, and, if you have a transmitting set, another mineral that will enable the use of heavy currents for close and fast work.

Keep your desk free of all unnecessary articles. Have a couple of sharpened pencils and a pad of paper always at hand. Sometimes an important message may come humming through the air when you are least prepared to receive it, and much valuable time will be lost hunting for your writing material. Have your call list where you can consult it

FROM the view point of efficiency, the simpler a wireless set is the more satisfactory will be the results. Most long distance receiving records are made with sets containing the least number of instruments and switches. Knowing how feeble are the currents that flow down to a wireless set from the aerial, it is obvious that these cannot be made to pass through an array of loading coils, loose-couplers, tuning coils, condensers and numerous switches and still retain sufficient energy to cause loud signals in the receivers.

quickly. If it is bound in book form, it is advisable to write out the stations that are within range on a sheet, so that they can be found without loss of time.

If you are manufacturing your own apparatus, try to use hard wood and fibre or hard rubber, for though soft wood and paper insulation can be made to work nicely, there is a far greater satisfaction in using apparatus that will "stay put." For instance, in California where the rarer woods are higher priced than in the Eastern states, enough mahogany for a good sized loose coupler, planed and cut to dimensions, can be obtained for 35 cents, if one goes to the right lumber yard. Surely in a case like this it would not be of advantage to use pine or ash.

Have your wireless table or desk of heavy, firm construction—a rickety affair goes a long way toward discouraging an otherwise efficient detector.

The fact that the leading wireless companies are adopting the two wire type of aerial would seem to indicate that this form is fully as efficient as the four, six and eight wire types. The amateur who is worried over his lack of wire can try this to good advantage, and he will find that if his four-wire aerial is made into a two-wire one, and doubled in length, he will have an increased efficiency in his receiving side, while his transmitting range will not be diminished. Furthermore, the two-wire aerial is easier to handle and has a neater appearance, since there are no sagging middle wires. Any amateur who has used soft copper wire knows how hard it is to keep all wires taut.

To bear out the contention that there is a great deal of "fancy work" expended on receiving sets that could be done away with, an instance may here be quoted. A standard make of loose coupler now on the market was tried out against the complete apparatus of a wireless telegraph company, the price of their apparatus running well into the hundreds of dollars, compared to a price well under the twenty-five dollar mark for the other. Tested out at distances of from 2,500 to 3,500 miles, the loose coupler, with 'phones and detector, no condensers or other apparatus of any kind, made a decidedly better showing than the other set with all its complicated apparatus and connections. On the high waves, the efficiency of the small set was still more marked.

SUBURBAN RADIO CLUB OF WASHINGTON

At the first meeting of the calendar year, the Suburban Radio Club of Washington held its election of officers. The results were as follows: John B. Brady, president; John V. Purssell, chief operator; George J. Rohrich, secretary and treasurer.

The club has enlarged its plans and attention is called to the fact that the membership is not limited to the suburbs of Washington, as was formerly intended, but now includes the surrounding country with Washington as its center.

One of the purposes of the club is to prevent "jamming," and this is being carried out by assigning ten minute periods to each member, at which time that member is supposed to be listening and receive any message intended for that station. This will prevent a great deal of useless calling, since everyone will know the schedule of the different stations.

Another interesting feature that is to be carried out is the encouragement of long distance sending and receiving. Special hours will be set aside for this purpose, at which time the best equipped stations will try to get in communication with distant stations. Some of the members are very well equipped in this line and they have heard amateur stations as far as 250 miles, with power input rated less than ¼ K. W. The scheme has every indication of being a success.

The club will be pleased to hear from other clubs as well as individuals, and all correspondence should be addressed to the secretary, P. O., Bethesda, Md.

Interesting Glimpses of a Famous Amateur and his Radio Laboratory.

CONTROLLING from shore a crewless motor boat by wireless on its 28-mile trip through Boston Harbor and out to sea, followed by its safe return to the starting place, is the recent accomplishment of John Hays Hammond, Jr.

His latest wireless-controlled motor boat, the *Natalia,* was built under the direction of Mr. Hammond and has

Two Views of John Hammond, Jr., Operating the Wireless-Controlled Boat from Shore. In the Center: The "Electric Dog."

Photos (C) International News Service.

proven highly successful in many trials. It is fitted with an aerial that gathers the waves sent out by the special transmitter of the inventor located on a bluff overlooking Gloucester Bay, Mass. By means of delicate detectors and relay devices the boat can be steered and run at any speed or stopped, and the various lights and searchlights, as well as other equipment, are under control of the operator at the transmitting key.

A clever application of selenium is presented in what Mr. Hammond terms "an electric dog." This is a three-wheeled vehicle driven by a motor and having at the front end two bull's-eye lenses. By holding a bright light in front of either lens, the inventor can make the vehicle follow him about. For instance, when the light is held in front of the left lens, the electric dog will turn to the left. A partition is placed between both lenses in order to prevent the light from shining through both lenses at the same time, when this is not desired.

Aerial Employed for Transmitting Waves to Motor Boat.

It has recently been announced that Mr. Hammond has completed the invention of a powerful explosive projectile. While details regarding this new invention are not plentiful or concise, it is gathered that the projectile contains an aluminum-thermic mixture which, five seconds after it leaves a siege gun, is transformed into a white hot, molten metal mass of 5,400 degrees Fahrenheit. When the projectile strikes, the liquid will set fire to any inflammable material it may encounter. And to prevent any efforts at extinguishing the conflagration, the projectile contains a separate chamber filled with hydrocyanic acid, the deadly fumes of which will prevent human beings from approaching the area in which the fire is raging. Mr. Hammond states that this new invention is particularly intended for destroying besieged towns, as well as combating dirigible balloons.

Again returning to the subject of wireless controlled craft, it is of interest to note that one of the suggested uses for this invention is in the defense of our coasts. One plan calls for a number of observation towers erected along the coasts at the most advantageous points, where a clear view of the sea can be secured. Observers in each tower could control one or more craft assigned to that portion of the coast. The wireless controlled boats could be sent out against a hostile fleet to discharge torpedoes when near enough to make a successful attack. It is said that such a scheme of coast defense would be less expensive to maintain than existing ones, and in all probabilities would be as effective, if not more so.

THE SWAN ISLAND WIRELESS STATION

One of the most interesting wireless stations in the tropics is that located on Swan Island in the Caribbean Sea. This wireless station is owned and operated by the United Fruit Company.

The Swan Island station consists of four self-supporting steel towers arranged in a rectangle measuring 300 by 600 feet. The power plant consists of two 50 H. P. Fairbanks, Morse oil engines driving two 25 K. W. 500 cycle alternators. The station covers twenty-two acres of ground, all of which is laid out in cement walks. A great portion of the station land is under cultivation. Fresh vegetables, turkeys and chickens are raised for the consumption of the station crew. The crew consists of three wireless operators, two engineers, an oiler, a cook, a messboy and three laborers, who, together with ten or twelve Grand Caymansmen who are engaged in cocoanut planting, comprise the full population of the island.

Men going to Swan Island are under contract to either remain at least eighteen months or waive the return transportation. Men remaining full time are granted return transportation to the United States via one of the Central American ports with six weeks' vacation and full pay. Some men have remained on the island two and one-half years. No women are allowed on the island.

The accommodations are said to be excellent; a cook and waiter being provided to prepare and serve the food to the operators. The men receive mail and fresh meat regularly every two weeks, and as they have a cold storage plant they are assured of fresh meat practically all of the time.

The buildings are all built of steel, sheathed with corrugated asbestos, and every man is provided with a separate room.

The United Fruit Company states that, contrary to the statements that have been published, there is no difficulty in getting men for this station, and to be assigned to it is a mark of reward for service on board ship or at other stations.

THE ELECTRIC FURNACE

Some time previous to the outbreak of the war it was reported from Germany that there had been there devised a new kind of electric furnace more durable and resistant to high temperatures than even the platinum furnace. The crucible of the German furnace it appears is wound with nickel wire and covered with a protecting jacket. For bedding the nickel wire, a pulp of kaolin, aluminum and asbestos fiber is used, and to protect the nickel from oxidation, this porous insulation layer is surrounded inside the furnace jacket with a thick layer of grains of carbon. The nickel-wire furnace will, it is claimed by the Germans, withstand a constant temperature of 1,200 degrees Centigrade, and even higher temperatures for brief periods.

PLANT CULTURE BY HIGH FREQUENCY CURRENT

(*Continued from page* 405)

leaved in place to complete the magnetic circuit.

The reader is referred to Figs. 10 and 11 for the method of mounting the transformer. The core is gripped between clamping strips of hard wood and bolted to a base of the same material. The primary and secondary leads are conducted to upright pillars of hard rubber having a brass rod running through the centre.

The transformer is placed in a container of wood, lined with zinc as shown in Figs. 12 and 13, which give the proper dimensions. In the cover of the container are bored four holes to pass the terminal rods.

When the transformer has been placed in the case, the latter is filled with transformer oil to within an inch of the top and the cover fastened down with screws. The addition of substantial handles at the ends of the container completes the work on this portion of the apparatus.

On Polyphase Subjects

Editorial

IN the January number of this magazine appeared an editorial which stated frankly and lucidly the policy of the publication. Supplementing this statement, the Editors endeavored to explain the lines of reasoning along which they worked in evolving this policy. As a preface to the remarks which follow, the matter will be briefly reviewed herewith.

The present MODERN MECHANICS is the direct outgrowth of a number of consolidated magazines, each of which made energetic efforts to reach the goal now attained by this magazine. The first of the several publications was *The Popular Electrician*, founded in Lynn, Mass., in 1890. This magazine was later taken over by the publishers of *Electrician and Mechanic* of Boston. The same publishers gradually absorbed the several other magazines of similar type, among which were *Amateur Work* and *Building Craft*. In January, 1914, *Electrician and Mechanic* was merged with *Modern Electrics* of New York and the combined publications were called *Modern Electrics and Mechanics*.

Each of these consolidations resulted in a bigger and better magazine—a magazine more completely satisfying the wants of the readers as these wants became known. The only other magazine in a similar field was *Popular Electricity and the World's Advance* of Chicago and the logical result was reached when this magazine was combined with *Modern Electrics and Mechanics* in July, 1914, under the name of *Popular Electricity and Modern Mechanics*.

The publishers soon realized that the inordinate length of the new name placed the magazine at a disadvantage, and, after serious

consideration, the first half of the title was dropped and the magazine called by its present name of *Modern Mechanics.*

Simultaneously with the appearance of the first issue under the shortened title, the publishers learned that not a little confusion had arisen among our readers due to the similarity between the title of *Modern Mechanics* with that of another magazine.

The thoughtful reader will readily understand how the name *Modern Mechanics* was adopted through a natural process of evolution; indeed, it has formed a part of practically every one of the several publications entering into its make-up. The question of possible confusion with another magazine of somewhat similar appearance but of a widely differing editorial policy was not taken into consideration.

The present magazine, after a long period of development, has reached its present splendid standing and a broader and more distinctive title can now be adopted.

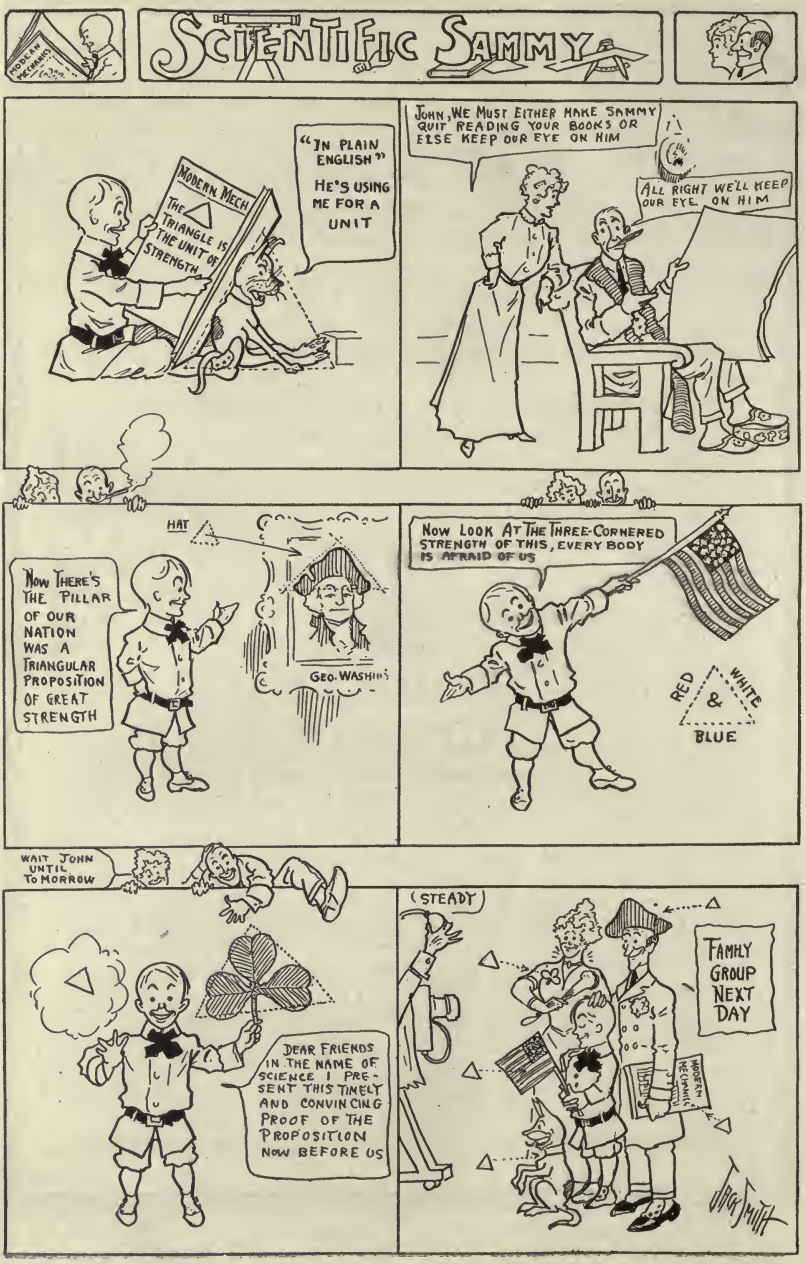
However, the question of a suitable title has been a difficult one of solution, for the scope of the publication is of exceptional breadth, but we feel that we have finally definitely solved this problem.

The aim of the Editors is to give the readers a brief resumé of all interesting in the fields of electricity, mechanics, invention and science, and to incorporate in each description, some feature of practical value — something that shall give the reader an opportunity to profit by the experience of others. This policy is adopted for the benefit of the lay reader in the first half of the magazine, and the requirements of the advanced or practical man are taken care of in the remainder of the pages, wherein hundreds of hints on easy ways to accomplish difficult tasks are offered.

Careful thought and analysis have convinced the publishers that the logical name for the magazine—the name most significant of its contents—is The World's Advance. In accordance with this decision, the title of this publication, beginning with the April number, will be:

THE WORLD'S ADVANCE.

February 15, 1915. THE EDITORS


SCIENTIFIC SAMMY
MODERN MECHANICS
"IN PLAIN ENGLISH" HE'S USING ME FOR A UNIT
MODERN MECH
THE △ TRIANGLE IS THE UNIT OF STRENGTH
JOHN, WE MUST EITHER MAKE SAMMY QUIT READING YOUR BOOKS OR ELSE KEEP OUR EYE ON HIM
ALL RIGHT WE'LL KEEP OUR EYE ON HIM
HAT
NOW THERE'S THE PILLAR OF OUR NATION WAS A TRIANGULAR PROPOSITION OF GREAT STRENGTH
GEO. WASHING
NOW LOOK AT THE THREE-CORNERED STRENGTH OF THIS, EVERY BODY IS AFRAID OF US
RED & WHITE & BLUE
WAIT JOHN UNTIL TO MORROW
DEAR FRIENDS IN THE NAME OF SCIENCE I PRESENT THIS TIMELY AND CONVINCING PROOF OF THE PROPOSITION NOW BEFORE US
(STEADY
FAMILY GROUP NEXT DAY
MODERN MECHANICS
JAS. SMITH

The
WORLD'S ADVANCE

Vol. 30 APRIL, 1915 No. 4

An Opening Word

WITH this issue the magazine greets its readers under its new name THE WORLD'S ADVANCE—a title truly significant of the contents.

As recent editorials have pointed out, the policy evolved during the past eight months is now firmly established and it will in no way be altered by the change in name.

Under the new title, the Editors will endeavor to present all that is new, interesting and useful in the fields of electricity, mechanics, science and invention and, furthermore, to present this material in a form that shall render it not only intensely interesting but instructive and of practical value as well.

THE EDITORS

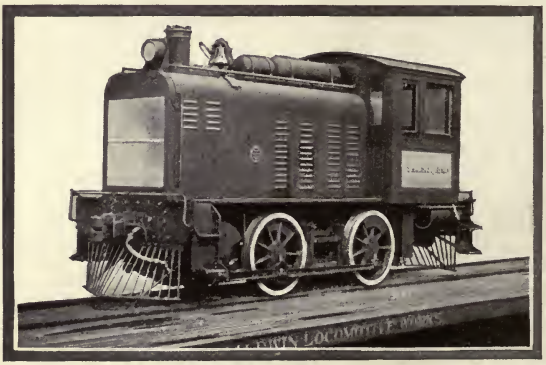
THE FIVE ICES

Experiments in the Massachusetts Institute of Technology have shown that water can be made to solidify into five different kinds of ice, each of which at certain temperatures and pressures changes from one into another with explosive violence. One kind, "ice-2," requires a very low temperature and great pressure to keep it from exploding into ordinary ice. Another kind will stay frozen at summer heat, provided it is kept under a pressure of 20,000 atmospheres. In nature such great pressures exist only in company with very high temperatures, and it is therefore entirely possible that some of these kinds of ice never existed until they were created in the experimenter's hydraulic press.

AN INTERNAL COMBUSTION LOCOMOTIVE

One of the oldest and largest locomotive shops in this country has recently turned out an industrial engine of radically new design. The locomotive, which is illustrated in the accompanying view, uses for its propelling power an internal combustion engine.

The new type of locomotive is equipped with a four-cylinder, water-cooled engine which is especially designed to stand heavy service conditions. It will burn either gasoline or kerosene and is equipped with a self-starter system similar to those used on most gasoline automobiles of today. An electric generator which is driven by the crank shaft of the engine through suitable gearing, supplies current for the self-starter and furnishes the necessary current to the electric headlight and other lights.



A Type of Locomotive That Is Designed Along the Same Lines As an Automobile. Its Tractive Power Is Developed by a Four-cylinder Engine That Uses Either Gasoline or Kerosene for Fuel.

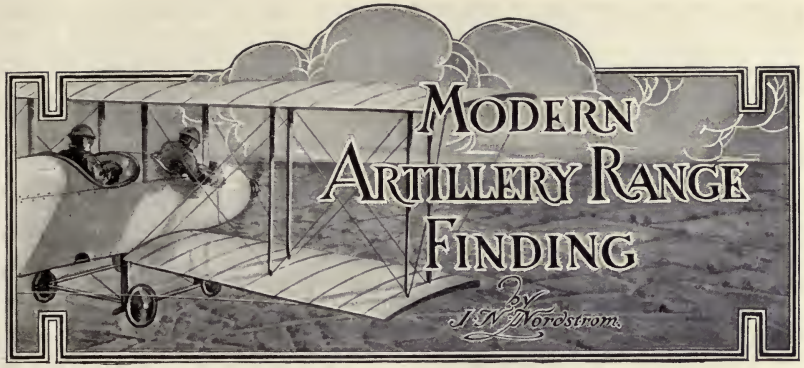
WOOD AND REINFORCED CONCRETE

It has been found that under certain conditions wood is a good substitute for the iron rods used to strengthen concrete beams. Cement combines as well with wood as with iron, and the cement coating effectively protects the wood from decay. It is believed that by using nine per cent. of pitch-pine for reinforcement, it is possible to make a concrete beam as strong as one that is reinforced in the ordinary way with one per cent. of steel.

EXPLODING MINES BY WIRELESS

From France came news a few months ago of success in the art of exploding ocean mines by wireless impulses, but the news was received with suspicion. Now we have an official report by United States Consul Benj. F. Chase, of Leghorn, Italy, that he personally witnessed two successful explosions of mines in the bay by wireless impulse. He states that Manrico Compare, the inventor, operated the mines at a distance of 2,500 feet, with many intervening obstructions.

There are strong probabilities that the wireless controlled mine will still make its appearance in the present European war.



THE firing of modern artillery pieces is no longer a mere matter of sighting. Guns are now placed behind a hill or mound and are not visible to the enemy; the indirect method of firing being employed. The range is determined by observers situated at vantage points on the ground, in balloons, or hovering over the enemy's lines in an aeroplane.

ARTILLERY is playing an all-important rôle in the great European war. On the Western front, where the Germans face the Belgian, English and French armies, a battle in the open is the exception rather than the rule. For the last few months both sides have entrenched themselves and long-range artillery duels have been practically the only evidence that a war is being fought. Occasionally the soldiers come out of their trenches and dug-outs in order to assault opposing trenches and thus gain ground; but generally speaking the war in the Western theatre has resolved itself into a continuous siege with the slaughter confined largely to artillery fire.

In order that artillery prove effective, it is obvious that the fire must be accurate. And no fact could more significantly illustrate the deadly accuracy of modern artillery than the recent statement of a medical authority that over 70 per cent. of all the wounds inflicted in the present war are due to shrapnel or shell fragments. But what has made such accuracy possible?

The prime requisite of accurate artillery fire is a suitable observation point from which the fire of the guns can be directed. As a general rule the directing and checking of the fire is made from a position as near the enemy's lines as possible.

One method of observing and directing artillery fire and which has been used with remarkable success is that of employing a captive balloon. The observer in the basket of the balloon has an unobstructed view over the lines of the enemy and, by means of a telephone line connecting to the different batteries, can tell the gunners the range as well as correct the fire of the guns after the bombardment has begun. However, it is not always possible to use an observation balloon, since it presents an

excellent target to the fire of the enemy, as well as to the bombs of hostile aeroplanes. Neither is it always possible to reconnoiter by cavalry patrols. In such instances the only remaining means of observation is the aeroplane.

Photography and Range Finding

Adverse conditions prevailing particularly on the battlefields of Flanders made it necessary for the Germans to employ the aeroplane for establishing their artillery range. Great success has attended the use of photographs taken from aeroplanes as a rapid means of finding exact ranges. From such sources of information as are available, the procedure for obtaining ranges as employed by the German army is as follows:

An aviator is sent aloft with an observer and the aircraft is guided over the enemy's lines in search of the guns. As soon as these are discovered, the observer trains the camera below in such a manner as to include on the photographic plate either a church spire, a barn, a solitary tree, a windmill or some other conspicuous object, as well as his own battery for which he is securing the range. Immediately after taking the photograph the aviator returns to the German lines and lands near the batteries. The photographic plate is rapidly developed and prints are made on bromide paper and sent to the officer in command of the guns. These prints appear as regular maps in relief, the trenches being indicated by bright lines and the cut-outs for the gun positions appearing as light squares in contrast to the darker, undisturbed earth. The calculation of the range is then resolved into a simple mathematical problem.

Referring to the accompanying diagram: One side of the triangle represents the distance from the German battery to the visible auxiliary point and can be determined by distance measurement. The auxiliary point is in the form of some conspicuous object which the observer has included in the photograph and which is within unobstructed view of the German lines. The second side of the triangle is a line drawn from

the same visible point to the enemy's battery. The length of this line is easily obtained by multiplying the photographic distance by the scale of the photograph; the latter being determined from the first two points. Two sides and two angles of the triangle being known, the range can be figured quite accurately. Although this range finding appears to be a painstaking task, it is considered necessary by the Germans because of the superiority of their mortar artillery. The object is not only the temporary silencing of the opposing battery, but the complete destruction of the guns and the annihilation of their crews.

Deadliness of Modern Artillery

The most destructive shell used by the Germans in conjunction with their mortar batteries is an explosive projectile which, when dropped down on hostile batteries from a considerable height, destroys both guns and men within a wide radius. As an example of accurate observing and destructive mortar fire, the siege of Antwerp stands preëminent. During the bombardment every gun turret on Fort Lierre was hit singly by shells from the powerful 42-centimeter howitzers. At Fort Waelhem the Austro-Hungarian 30.5-centimeter guns were equally successful; while at a certain section of the defences the 21-centimeter siege guns dismantled gun after gun comprising the open battery of the main fortifications.

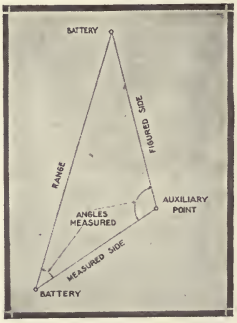
The long ranges over which artillery duels are conducted—often beyond the scope of natural vision—have rendered the aeroplane an indispensable factor in this branch of warfare.

The art of hiding or disfiguring the guns makes observations from an aeroplane a very difficult and ofttimes unreliable expedient, especially from the great heights at which the aviators are compelled to fly in avoiding undue risk from rifle and artillery fire. As a rule, the aviator or observer cannot determine the exact position of a battery until he sees the fire from the guns. In order to corroborate an observation flight as well as check the details of an observer's re-

port, numerous photographs are usually taken. These are immediately developed and printed upon landing. The photographs, in conjunction with the report of the observer, are invaluable to the general staff.

Great Skill and Steady Nerves

It is not a simple matter to take photographs from an aeroplane in full flight. It is more than a matter of pointing the camera downward over the side of the aircraft and pressing a bulb. Vibration in all parts of an aeroplane fitted with a powerful motor compels the observer to stand upright in taking a photograph, in order to eliminate the vibration as much as possible and secure sharp definition on the negative plate. The arms must not rest on any part of the airship and, in this trying position, the observer must hold the camera over the side of the fuselage, focus the camera and take the photograph. Great skill and steady nerves are obviously essential. Accurate observations can only be made at a height not exceeding 4,000 feet, while photographs taken at altitudes of from 2,000 to 3,000 feet are considerably enlarged to be of use. The hostile artillery and rifle fire is quite effective to heights of 5,000 feet, so it is little wonder that aeroplanes are shot down daily in performing their scouting work and taking photographs for range finding.



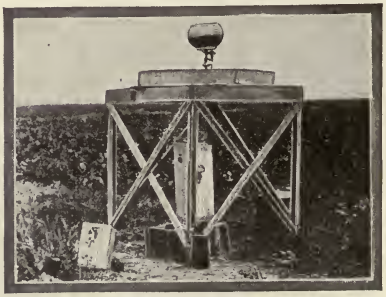
Method Employed for Determining Artillery Range.

Of the many brave deeds called for in modern warfare, perhaps none is more trying and more deserving of praise than those of the aviator and his passenger in the performance of their all-important duties. And in many instances it is due to them that the artillery fire is accurate and effective, resulting in the attainment of important gains or even great victories for their armies.

A LIGHT TO TRAP MOTHS

The beet ranches of Southern California are protected from the ravages of the night-flying moths, mostly cutworm moths, by a novel light trap which is set up in the fields; a single trap capturing from 1,500 to 7,000 moths in a single night. One company near Oxford has eight such traps in use and during the past season the results were equal to the highest expectations.

The device is of reasonably simple construction, being a powerful light enclosed in a glass globe and suspended over a shallow galvanized iron pan containing oil. The insects, flying against the globe, fall into the pan and perish in great numbers. As a large proportion of the moths are females, carrying great quantities of eggs, the results of a season's catch can easily mount high in the millions. The light is furnished by acetylene gas, a tank being set below the frame carrying the tank, though an electric light has been used with equal success.



This Light Attracts Many Moths to Their Doom in the Tank That Surrounds It.

A CAMPING OUTFIT FOR MOTORISTS.

Of the many new devices for motorists that are constantly making their appearance on the market, perhaps none is more interesting than a camping outfit that has been invented by a Westerner. The outfit consists of a tent of suitable size to accommodate the motorists, a folding bed measuring four feet wide by six feet six inches long, and two folding camp stools. The bed is so constructed that it will not sag, even when holding a person of great weight. The tent is fitted with a sunshade that can be extended several feet from the tent proper. The bed can be folded and placed in a case fitted with legs and which may be converted into a substantial table finished in fumed oak and held together with steel parts. So strong is this table that it has been tested and is claimed to have withstood the most severe storm when securely braced.

The entire camping outfit packs into a case measuring 10 by 18 by 49 inches and can be readily placed on any automobile, weighing but 100 pounds.

Various Views of an Automobile Camping Outfit Which Weighs Less Than 100 Pounds and Occupies But Little Space.

This Automobile Camping Equipment Comprises a Tent, Camp Stools, a Substantial Table and Other Furniture for Outdoor Life.

SAFEGUARDING THE BANKS OF A RIVER

One of the big tasks the Government has undertaken in its fight to control the rebellious Mississippi river is the repairing of its banks. These are constantly subjected to the terrific wearing and tearing process of the great volume of water

rushing to the Gulf of Mexico. The soft dirt banks are being cut away at an alarming rate in many places and the Government barges are kept constantly at work during the summer and fall months.

One means of stopping the inroads of the river into nearby farms is the use of huge mattresses of willows which are sunk alongside the bank, weighed down with stone. The mattresses are made on board the barges and when completed are shoved into the water with the aid of machinery. The accompanying illustration shows workmen about to shove a big willow tree mattress over the side of the barge.

To Prevent River Banks From Being Washed Away, Mattresses of Willows Are Used.

USES OF ALUMINUM FOIL

It appears that the use of aluminum foil has greatly increased in recent years, owing to the success of long and expensive experiments that have much reduced the cost of manufacture. The rolling process requires six stages, the last of which produces a full sixteen ten-thousandths of an inch in thickness. In order to obtain the very thinnest foil, the workmen lay several sheets together and either roll or beat them like goldleaf. Aluminum foil is now frequently used instead of tin-foil for wrapping such articles as cheese, candy and tobacco. It is also used in the Government printing office in place of gold-leaf for lettering on bound volumes of Government reports.

Aluminum foil is used to some extent in the condensers employed for wireless.

THE UNITED STATES PROTOTYPE KILOGRAM

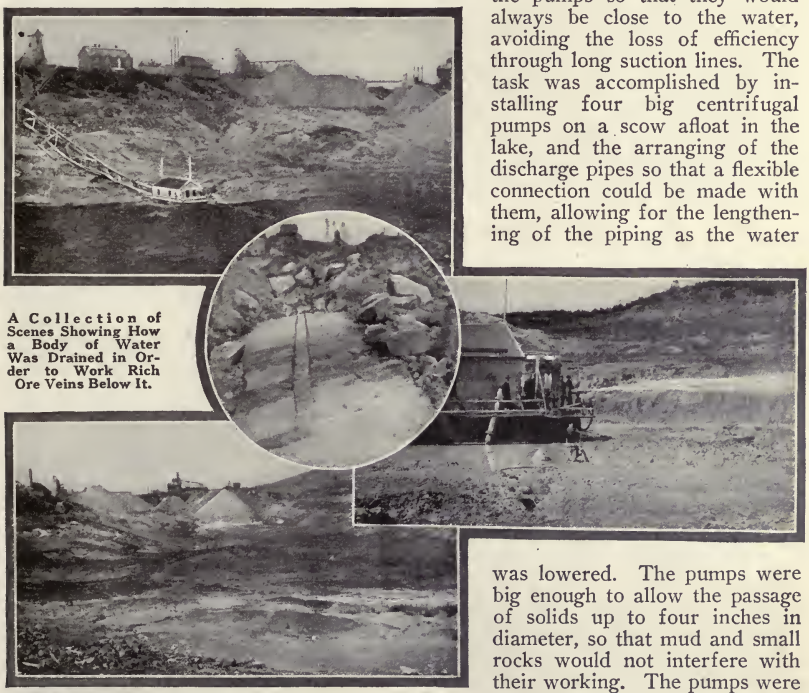
In a vault at the Bureau of Standards in Washington, D. C., is carefully kept a kilogram weight that serves as the standard for the American pound weight.

The Kilogram Weight That Serves as the Standard for the American Pound Weight, Kept in a Vault at the Bureau of Standards, Washington, D. C.

It is the equal of 2.2046 pounds avoirdupois; the standard pound being equal to a slight fraction more than half of a kilogram.

ELIMINATING A LAKE

A lake was in the way; it interfered with the industrial development of the surrounding district. The engineers in charge calmly pumped the water out and dried it up. Little things like natural lakes cannot presume to stand in the way of dividends, and this one was simply eliminated.



A Collection of Scenes Showing How a Body of Water Was Drained in Order to Work Rich Ore Veins Below It.

The body of water in question was Kerr Lake, formerly situated in the midst of the mining district of Cobalt, in Ontario, Canada. It had an area of 30 acres and contained about 400,000,000 gallons of water. The reason for its elimination was that there are a large number of rich veins of silver ore traversing the district, which it pays to work right up to the surface. That could not be done under a large body of water, and calculations proved it cheaper to dispose of the water than to lose the valuable ore. Besides, there was a strong probability that other veins could be found if an opportunity existed to examine the surface—a probability that was fully justified after the operation had been concluded.

The problems were a little difficult, for some means had to be found to locate the pumps so that they would always be close to the water, avoiding the loss of efficiency through long suction lines. The task was accomplished by installing four big centrifugal pumps on a scow afloat in the lake, and the arranging of the discharge pipes so that a flexible connection could be made with them, allowing for the lengthening of the piping as the water was lowered. The pumps were big enough to allow the passage of solids up to four inches in diameter, so that mud and small rocks would not interfere with their working. The pumps were driven by electric power and delivered the water into a 20-inch pipe which conveyed the water to another lake about half a mile away. Two 250-hp. motors operated the four pumps.

The pumps removed the water at the rate of 6000 gallons per minute for 38 working days. At first the clear water was taken out very rapidly, but when the bottom was neared, a mass of semi-

liquid mud had to be handled. A stream of water under pressure was used to wash the mud into the pump intake.

Several rich and important veins of rich silver ore were uncovered after the pumps had done their work, some of them containing ore worth nearly two thousand dollars a ton.

A "MOONSHINE" STILL IN CHINA

On the outskirts of Shanghai, China, is a "Moonshine" still, very closely resembling the form of stills used in some parts of Kentucky for making illicit whiskey.

Chinese "Moonshine," or *Samshu,* as it is called, is a pale liquid made by distilling rice water. It somewhat resembles the Japanese drink, *Saké,* which is drunk while hot. The manufacturing process of *Samshu* is as follows:

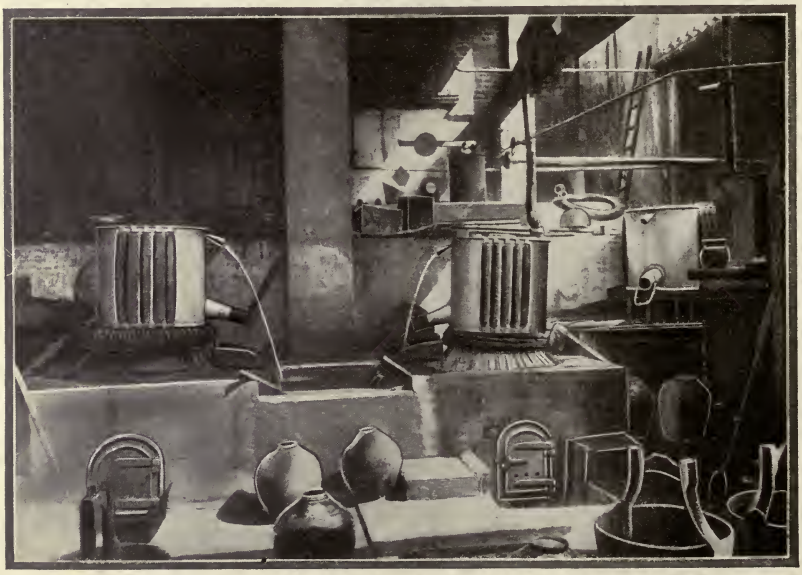
Large brass boilers in which are placed condensing coils are partly filled with rice water and mounted upon a small brick oven in which is burned charcoal. The heat vaporizes the alcoholic *Samshu* and it is condensed and drawn off at frequent intervals.

Samshu has a peculiar oriental odor and flavor, offensive to a foreigner, but quite popular with the native population. It is sold only in native stores and costs somewhat less than one cent per glass.

THE PHONOSCOPE

From far away India comes a report that a Professor Albe of Lahore has invented a machine that he calls the "Phonoscope," the use of which enables the totally deaf to perceive sounds by means of the eye. The machine can be used in conjunction with either speech or music.

No details of the "Phonoscope" are yet available, although it is surmised that it employs photography in some form or other. In the past, motion pictures have been taken of the effect of different sounds, particularly in conjunction with telephony and wireless telephony, and the new invention may be similar.



A Complete Distilling Outfit Used by the Chinese for the Making of "Samshu," a Popular Oriental Beverage

Combating Ocean Breakers with Compressed Air

by Robert G. Skerrett

EACH year certain sections of our coasts are ravaged by heavy seas with a resultant loss of property. Massive breakwaters of concrete, steel and stone are often powerless in the face of the huge breakers. At last a solution has been found in the form of a pneumatic breakwater; numberless air bubbles shattering the waves and robbing them of their power.

AFTER fourteen years of experimental and practical work, Philip Brasher, a young engineer graduate of Princeton University, declares that he has the only feasible means of eventually protecting the sandy stretches of our Atlantic seaboard from the erosive action of storm waves. Particularly, he offers his apparatus to meet the present pressing need of certain portions of the New Jersey littoral.

As most of us know, bulkheads and jetties of heavy pilings and stout planking—some of them steadied by rock ballast—have been the ordinary mediums by which the beach engineer has sought to arrest or check the greedy inroads of the storm-aroused Atlantic. These, in many cases, have been constructed without regard to cost, and yet they have been battered into kindling by the awful blows of the angry breakers stirred up by southeast gales. Worse than this, adjacent territory has been cut into and undermined, tumbling one after another expensive cottages and hotels right into the swirling waters. A remedy and an effective one is urgently needed if further destruction is to be arrested. Indeed, vital topographical changes may be wrought if lasting bulwarks are not reared soon. But what sort of barriers will suffice short of prohibitively expensive breakwaters? Mr. Brasher says he

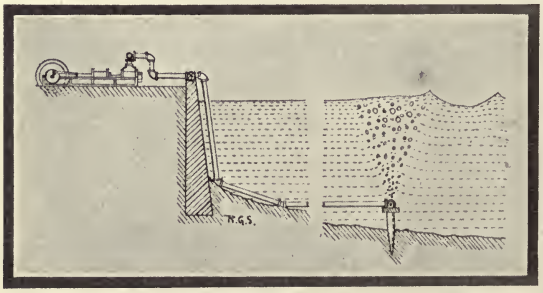
can furnish a fitting remedy by employing compressed air.

As he puts it, "My air breakwater is based upon the demonstrated scientific fact that air bubbles, rising from a considerable depth, will completely destroy the form of the waves and reduce their height to a point where they are no longer capable of doing damage.

"What gives a wave its power and what is its mode of travel? There is only one time at which a wave is really dangerous to anything substantial, and that is just as it is curling to break. It is then undergoing a change from what is called an oscillatory wave—or one whose particles merely oscillate—to a wave of transmission, *i. e.,* one whose particles *travel* along in a certain direction. At that particular time, the momentum attained by the tons of water, elevated to whatever height it may be, and falling from that height, is practically irresistible. So that if it be possible to cause a wave to break before striking any object to be protected, the capacity of the wave to do harm is destroyed and it becomes merely a bubbling mass which looks rough but is really harmless.

"Wave motion is described as the transference of energy by vibration. In other words, each particle of the wave merely vibrates and the motion is carried forward by the impact of the vibrating particles. Therefore, if this vibratory impulse can be broken up or arrested, then waves can be halted and their further propagation stopped. That is exactly what I accomplish by utilizing a barrier or blanket of air bubbles mounting surfaceward from a suitably perforated conduit lying on the ocean bed and squarely across the path of the advancing seas. These bubbles, expanding as they approach the surface, disrupt the water and force widely apart the very particles which must be in intimate contact in order to facilitate the transmission of the wave forming vibrations. With intervening air gaps this is quite out of the question, and, therefore, I am thus enabled to break up billows provided I can deal with them before they have started to tumble over and have become breakers."

An instance will explain the practical application of his ingenious invention and will give the details of one of Mr. Brasher's installations. To use the inventor's own words: "I installed a plant for a quarry on Cape Ann, Massachusetts, where the shipping pier was exposed to the sea. The company had great difficulty in loading their barges except when the sea was nearly calm. I ran a pipe along the edge of the pier and down into the water at the outer end, and thence along the bottom oceanward for a distance of a hundred feet. At that point, another pipe, four inches in diameter and perforated at suitable intervals, was connected to the first conduit at right angles. The perforated pipe was three hundred feet long and lay at an average depth of forty feet upon a very rocky bottom. When the compressed air was turned on the discharge rose from the sea-bed in a wide bubbling zone that smothered all oncoming waves, and effectually protected the end of the pier so that barges could lie there in security and load without difficulty. The air consumption was three cubic feet per minute per linear foot of perforated pipe, that is to say, nine hundred cubic feet in that interval, at a pressure of twenty pounds per square inch. This impulse was all that was



Working Diagram of the Principle Employed by Philip Brasher in His Pneumatic Breakwater.

Views Along the Jersey Coast That Suffers Each Year From Heavy Seas. In One View Is Seen a Wrecked House, While in Others Are Shown the Breakwaters and the Surf.

needed to overcome the pressure of the hydrostatic head of forty feet."

The inventor states that his breakwater will be of service under the following conditions, which convey some idea as to its remarkable range of applications:

"Dredges can be kept working in the most exposed places during the roughest weather. The erection of permanent breakwaters, piers, lighthouses and dams may be continued steadily, no matter what the weather conditions. Half completed structures may be protected until finished. Lightships can ride out the roughest gale in an artificial lagoon of calm sea. Stranded vessels can be protected from the pounding of the waves until floated."

WATCH KEPT RUNNING BY FOOTFALLS OF OWNER

Councilman Schmidt, of San Diego, is the proud possessor of the only watch in the world which winds itself. He bought it forty years ago in Kansas, and it was so old then that he could not find out when it was made. It was a square French time-piece, having been made at some far off-date in Loire, France, and it is so arranged that a lever oscillates with every footstep the owner takes, thus keeping the spring tightened. It is the only watch on record, according to New York experts, which winds itself by the jar in walking. It keeps perfectly accurate time in spite of its peculiarities of construction, and has worn out several good cases. At present it is encased in a new gold case. A key is provided for emergencies, so that if the owner should be ill or have to refrain from walking for several days, the owner can wind the watch.

If you enjoy THE WORLD'S ADVANCE, please tell your friends. If you do not, write us your reasons and suggestions.

A Three-Wheeled Tractor That Is Proving Highly Successful in Different Fields of Application. Here It Is Seen Drawing a Snow Plow.

AUTOMOBILE TRACTOR OF NEW DESIGN

In Chicago there is being used at the present time a tractor of new design. It is a three-wheeled vehicle and is sufficiently powerful to haul from fifteen to twenty trailers made especially for use with the tractor.

The new tractor is equipped with a four-cylinder water-cooled motor located in the rear of the machine instead of at the front as is usual. The two wheels at the rear are driven by the engine and propel the vehicle, while the wheel at the front is used for steering.

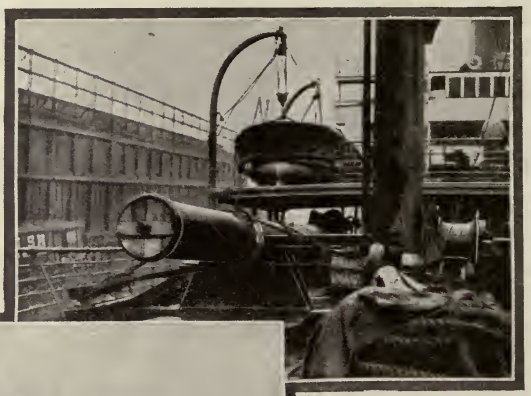
INTERESTING BRICK WALL

On one of the side streets of San Diego, California, may be seen the amusing and amazing spectacle of a small red brick house completely stuccoed with bits of broken crockery, glassware, china and porcelain; while in nearly regular patterns larger pieces of Japanese decorative china and vases, beer bottles, plates of old blue china and chunks of dark brown and green sewer tile, vie with glass tumblers, steins and earthenware jugs and jars for vividness of color and design, all forming a part of the most brilliant and dazzling display of exterior house decoration that has yet been seen. This queer house is the home of an eccentric Englishman who takes delight in the wonder and curiosity of his neighbors and the passers-by. They view with undisguised wonder the pile of barrels filled with pieces of once-treasured china and glass, now waiting his pleasure in prospective addition to the already alarming assortment of vari-colored decorations. The foundation-piers are of varied structure also, one side of the house being supported by massive looking walls of cobble-stones, while the other rests on piles of glazed tile. The chimney, too,

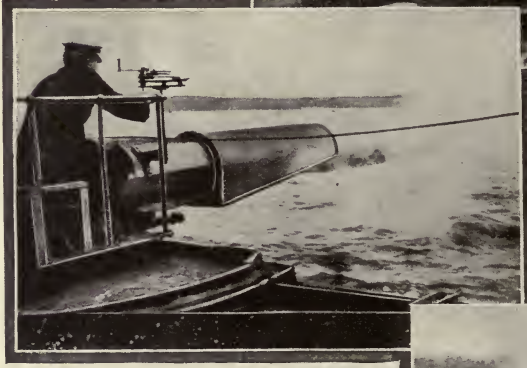
One of the Sights of a Californian City Is the Brick Wall of a House That Is Studded With Broken Crockery, Glassware and Porcelain.

which is on the rear side of the house, is a peculiar one, since the red bricks are interspersed with white glazed ones, set in the most bewildering crazy-quilt patterns imaginable. Evidently the owner and designer of the dwelling does not believe in monotony of house decoration.

A night view of the Panama-Pacific International Exposition now being held at San Francisco. The conspicuous structure appearing in this view is the Tower of Jewels--a mass of glass jewels of many different colors and extreme brilliancy. The numerous searchlights form an important part of the illumination effects.



One of the sixteen-inch guns recently shipped to England on board the S. S. "Transylvania." This view shows how these massive pieces of ordnance were lashed to the deck of the liner.



At the Left: A torpedo leaving the torpedo tube of a British destroyer. Below: A Canadian despatch rider firing his rifle while traveling at thirty miles an hour.

Below: A German sentry in Poland.

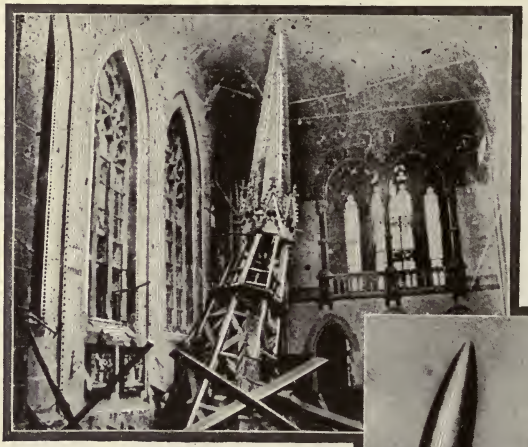
Photos. Copyrighted International News Service.

The toll of war: A battlefield on the western front after a severe engagement in which the German infantry charged across a field with heavy losses.

A French officer's living quarters on the battle line in France. Owing to the necessity of digging themselves in, the German, English, French and Belgian soldiers are obliged to withstand many hardships through lack of proper shelter. This particular shelter is considered a palace by the soldiers —and there are very few as comfortable.

Even the Red Cross ambulances are obliged to stop when challenged by a sentry and the chauffeur must show his credentials.

Photos. Copyrighted International News Service.



The interior of a French church near Bethune, which was wrecked by a German shell. The shell in crashing through the roof of the church carried the steeple along with it.

The accompanying illustration shows a cartridge clip and cartridges such as used in the French military rifle. A German bullet has passed through the four cartridges, yet through some freak of fortune they have failed to explode. The soldier who was carrying this clip was not injured.

A woman and her children who were evicted from their home through lack of funds, the husband having enlisted as a soldier. The landlord has been harshly criticised by the local citizens.

An Austrian battery shelling a Russian position in Galicia. The mountainous nature of this territory, together with the heavy snowfalls and intense cold, has made the fighting there replete with hardships.

How Switzerland guards her neutrality and is prepared for war: Swiss soldiers in the Alps carrying snow to make trenches.

In the heavy snows of Poland the Germans have been obliged to use rough sleighs, such as the one herewith illustrated, for the transportation of their wounded to the hospitals.

Photos. Copyrighted International News Service.

The army of English women in the making. Above: The army marching through the streets of London. At the left: A member of the Women's Volunteer Reserve dressed in the regular uniform and with the equipment pack on her back.

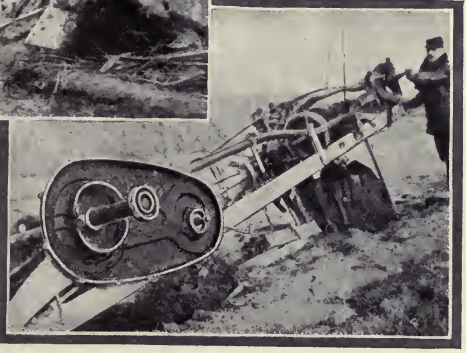
Members of the Women's Volunteer Reserve receiving a lesson in telegraphy. The object of the organization is to train women in first aid work, cooking, riding, driving, care of horses, and marksmanship.

Photos. Copyrighted International News Service.

A cargo of flour and wheat in the hold of the S. S. "Baxstan," at the docks of the Bush Terminal, Brooklyn, just before the vessel sailed for Liverpool with a big cargo of foodstuff.

Russian officers observing the effect of shellfire in Galicia, during an engagement with the Austrian forces. Both armies are using light field artillery because of the rugged nature of the country.

French heavy artillery shelling Steinbach in Alsace. It will be noted that in a spirit of humor the artillerymen have painted German names on their guns.



The remains of one of the motor transport wagons of the Allies after being struck by a German shell. Every movable part of the machine has disappeared, leaving only the bare framework.

Photos. Copyrighted International News Service.

Italian soldiers issuing tickets for soup to the homeless people of Sora, Italy. The Italian Government immediately after the earthquake was confronted with the problem of nourishing and housing the unfortunate inhabitants of the affected communities.

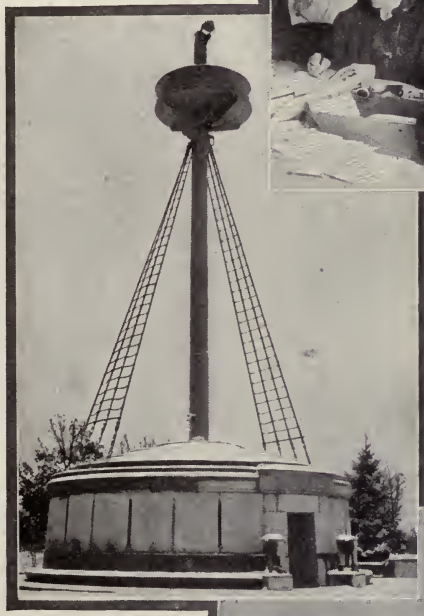
A scene among the wreckage of an Italian town after the earthquake.

Soldiers excavating among the ruins in the town of Sora in search of earthquake victims. About one hundred persons were buried in the debris caused by the earthquake.

Removing the dead from the earthquake ruins at Sora, Italy. In this town the loss in property and lives was very heavy.

Photos. Copyrighted International News Service.

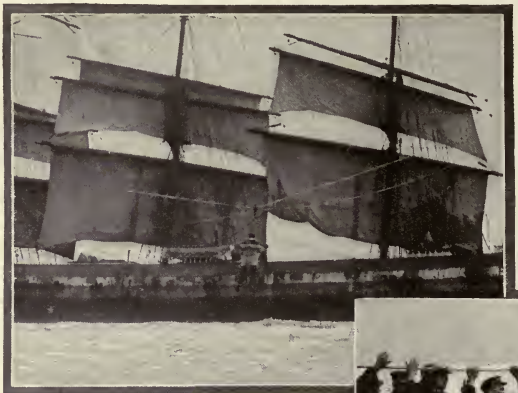
An idea of the work entailed in registering prisoners in the present war is presented in this picture. Here is seen a portion of the card index files kept by the German War Office for registering the German soldiers that have been captured by their enemies.



The new Maine memorial at the Arlington Cemetery, Washington, D. C. The monument was dedicated on February 15th. The base consists of a new turret, while the fighting mast is one taken from the ill-fated warship that was blown up in Havana harbor a short time prior to the Spanish-American war.

A school scene in the section of Alsace now occupied by the French forces. In this view a French soldier is seen teaching the children how to speak and write French.

Photos. Underwood & Underwood and Janet M. Cummings.



The four-masted sailing vessel "Hougomount" that was recently driven ashore in a storm off Fire Island, New York. In this view is seen a member of the crew being brought ashore by means of a breeches buoy.

A member of the crew of the "Hougomount" brought to shore in a breeches buoy.

Another view of the life saving corps at Fire Island rescuing the crew of the sailing vessel.

A view of the "Hougomount" that was driven ashore during a storm, showing its close proximity to the beach. The sailing vessel was in danger of being pounded to pieces by the heavy breakers.

Photos. Copyrighted International News Service.

Awarding twenty $10.00 and $5.00 gold pieces to the gun crew of the "Georgia" that won the target practice off the Virginia Capes.

E. A. Darowsky, the best shot in the U. S. navy. This gunner made three hits out of twelve shots in one minute and forty-six seconds with the 12-inch gun on which he is sitting, at 2,000 yards. He is the first gun pointer of the "Georgia" and is 18 years old. He hails from Bayonne, N. J.

Below: Gunners of the "Georgia."

Above: The U. S. submarine boat "L-1" recently launched at the Fore River shipbuilding yards, Quincy, Mass. This craft is the largest submarine boat now in the American navy.

Photos. Copyrighted International News Service.

After the big naval engagement between the German and British fleets off Falkland Islands, in the South Atlantic: In the foreground may be seen numerous sailors from the sunken German warships waiting to be rescued. The battleship in the background is Admiral Sturdee's flagship "Invincible."

A French dirigible airship leaving its shed for a flight. The French army is equipped with quite a number of dirigible balloons of the flexible type, but thus far they have not been used for actual military activities of note.

The German battle cruiser "Bluecher" about to capsize and sink to the bottom after being torpedoed by the destroyer seen at the left. This battleship was lost during the fight between the German and British fleets in the North Sea. Dreadnaughts partook in this engagement.

Photos. Copyrighted International News Service.

MAKING WAR ON CARDBOARD SOLDIERS

An unique method of preparing the members of the National Guard for war, especially for night attacks, has been invented by Capt. John J. Richards of Providence, R. I.

Capt. Richards and his men of Troop B are getting about as near to real warfare as is possible without danger to themselves. The "enemy" is represented by cardboard targets set up in various spots throughout a wood and on several roads. The cavalrymen are then given commands to charge at various distances. A lively action with plenty of firing follows. After each attack has been worked out to the satisfaction of the commanding officer, the holes in the "foe" are covered with paper and the targets are used again.

The targets, which are cut from large sheets of cardboard, have aroused keen interest among the army officials of Rhode Island. They are the exact size of a man and each is painted to represent a soldier in uniform. From a distance it is said that the targets cannot be distinguished from human beings. Real bullets are used in the fighting; the practice being accordingly of a practical nature and not of the imaginary or theoretical sort as is usually the case.

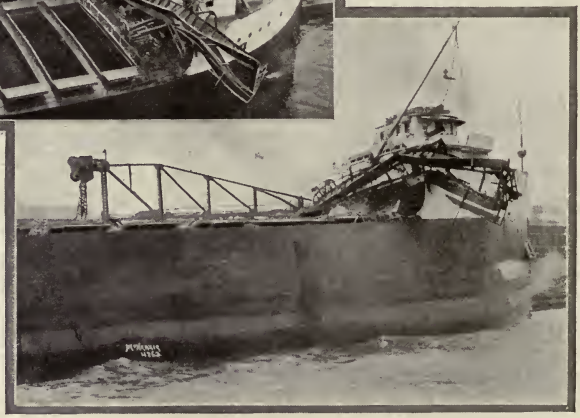
Cardboard Targets That Are Being Used by Members of the Rhode Island National Guard for Target Practice.

THE WIND'S HARVEST

When an engineer builds a steel structure he is usually pretty careful to make liberal allowances for all the stresses to which it may be subjected, building it strong enough to resist every strain that can be imagined as acting on it. Resistance to the wind is one of the things

always figured upon, but sometimes the wind is stronger than the engineer imagines. Such a case is shown in the accompanying reproductions, which show an ore dock at Duluth that was wrecked by a high wind. Ore is brought to the Duluth steel works from the Michigan and Minnesota mines in large steamships built especially for such carriage, and to make unloading rapid and cheap, these steel docks are built so that an arm reaches over the vessel and an excavator dips into the cargo and carries a loadful to the ore pile. This one was built a little too weak, with the result that the wind completely wrecked it, as well as inflicted considerable damage on the steamer. The Duluth winds are by no means zephyrs of spring, as attested by this incident and many others of a similar character.

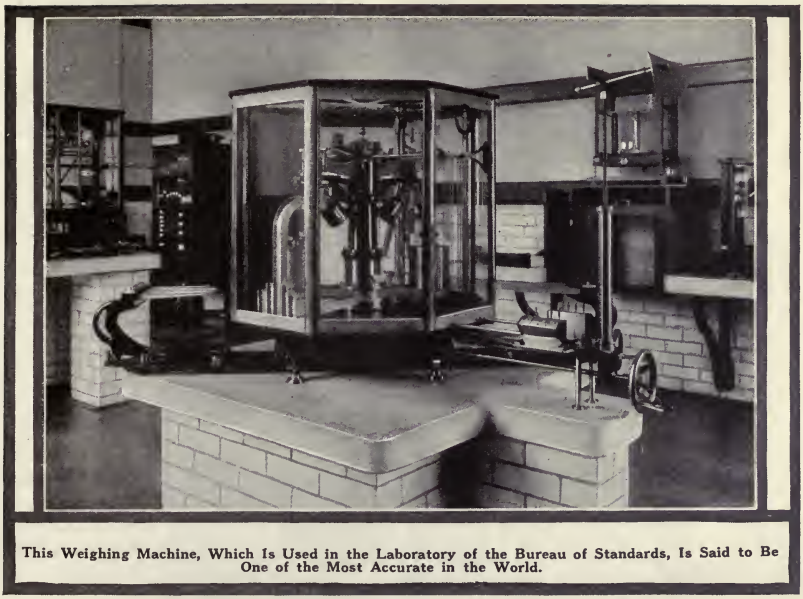
Below: Another View of a Great Lake Steamer That Was Partially Damaged by the Collapse of a Crane. Steamers of This Kind Are Especially Constructed for the Handling of Ore.



Above: View Looking Down on a Lake Steamer That Was Damaged by the Falling of an Ore Handling Crane. The Crane Was Wrecked by the Force of the Wind.

NEON GAS IN ILLUMINATION WORK

The rarefied atmospheric gas known as neon, which was first isolated in 1898 by fractional distillation of liquid air, has been successfully used in electric lighting. If a mild electric current passes through a tube that contains a minute quantity of neon, it produces a golden light that is soft and agreeable to the eyes, and makes the objects it illuminates stand out with remarkable clearness. The neon tubes require less current than the mercury-vapor lamp and give out less heat than any other form of electric light. Moreover, the electric current disintegrates the gas very slowly; the tubes will produce light for from eight hundred to one thousand light hours without being renewed.



This Weighing Machine, Which Is Used in the Laboratory of the Bureau of Standards, Is Said to Be One of the Most Accurate in the World.

A WEIGHING MACHINE OF GREAT PRECISION.

One of the most accurate weighing machines in the world is that used in the laboratory of the Bureau of Standards in Washington, D. C. This machine was designed especially for the work of the Government. There are only four others of a similar kind in the world. The weights are adjusted on the scales by the wheel that appears at the right of the machine which is shown in the accompanying illustration. The scale is intended for the testing of 50-pound weights, yet it possesses such great accuracy that a fly's wing can be weighed with precision.

NOVEL IDEAS DISPLAYED AT INVENTORS' SHOW

A vast amount of ingenuity was recently presented in the form of many inventions on exhibit at the national inventors show held in New York City.

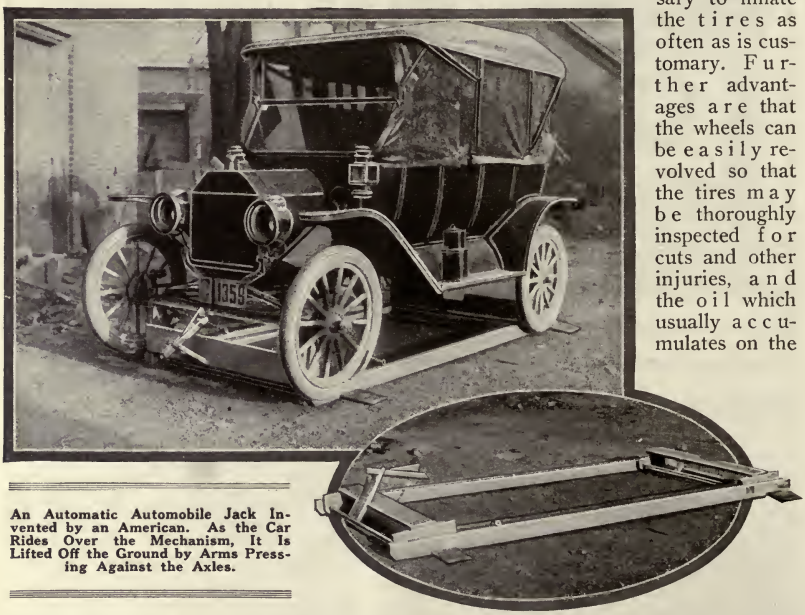
One of the inventions which aroused much interest was a bumper or fender for automobiles. According to the manufacturer of the fender, the device is a "veritable breastwork when in danger of collision; the only bumper in the world that protects the car, child or adult occupant, stops the car and does its true work when other efforts fail."

Another invention that interested automobilists in particular was a device for dimming headlights. Numerous other similar devices for accomplishing the same results were displayed. An array of special lenses and attachments for headlights, enabling the throwing of a beam of light on the road and not into the eyes of oncoming chauffeurs, also attracted much attention.

Then there was a life-saving buoy. According to the inventor, one carload of these buoys would have saved the life of everyone on board the *Titanic*. The new buoy consists of a chamber in which three persons can sit; a lid being screwed on over their heads, while a weighed tail serves to keep the buoy up-

right. The occupants have fresh air, light, rations, water and means of signaling to passing ships. All one needs is a deck of cards as well as some chips to rob a shipwreck of all its terrors.

One inventor demonstrated a portable fence made in sections. With his fence, enclosures such as paddocks, pig pens and fields can be enclosed with little trouble and practically no tools.



An Automatic Automobile Jack Invented by an American. As the Car Rides Over the Mechanism, It Is Lifted Off the Ground by Arms Pressing Against the Axles.

Women inventors vied with the men inventors at the show. One representative of the fair sex was demonstrating a self-threading needle for hand sewing and sewing machines. Another woman showed a little device that resembled a whistle but in reality proved to be a medicinal inhaler possessing many striking advantages.

The *Queen Elizabeth,* one of England's latest dreadnoughts, carries 15-inch guns that are capable of firing a one-ton projectile 30 miles. These guns have been used in bombarding the Dardanelle Forts.

AN AUTOMATIC AUTOMOBILE JACK.

Among the recent automobile inventions is an automatic automobile jack the purpose of which is to lift a car from the floor of a garage. By thus relieving the tires of the weight of the automobile, two advantages are gained: Firstly, the tires last longer, and secondly, it is not necessary to inflate the tires as often as is customary. Further advantages are that the wheels can be easily revolved so that the tires may be thoroughly inspected for cuts and other injuries, and the oil which usually accumulates on the floor of garages is prevented from reaching and rotting the rubber of the tires.

The mechanism of the automatic jack is quite simple. Four standards are arranged so as to lay flat when not in use. When an automobile is run onto the jack, the front axle passes over the rear standards and travels forward until it engages a projecting arm. This arm is so connected with the standards that they are all lifted by the forward motion of the arm and move upward directly beneath the axles of the automobile. In this manner the momentum of the car causes it to lift itself. In order to protect the automobile from possible danger,

small casters are placed under the front of the mechanism so that should an automobile come in violent contact with the projecting arm, the car and jack will slide slightly forward.

DISMANTLING A MOTORCYCLE TO BUILD A MOTOR BOB-SLED

At the beginning of the winter three young men of Fort Wayne, Ind., decided to make the most of the cold weather and snow. They dismantled a twin-cylinder motorcycle and mounted the engine at the front of a bob-sled which they made, while the rear wheel of the motorcycle was placed between the two sleds and driven by the engine through the chain transmission. An automobile steering wheel completed the motor bob-sled.

On a level highway it is said that the sled has made speeds in excess of 50 miles per hour. The nine-horsepower motorcycle engine can carry the three passengers of the bob-sled over city streets and country roads with ease.

This motor-bob is very similar in design to that which was described in the January issue of MODERN MECHANICS.

A ONE HORSEPOWER MOTOR THAT FITS THE VEST POCKET

At the national inventors' show recently held in the Grand Central Palace, New York, one of the principal attractions was a motor which, while not larger than an ordinary watch, produced one horsepower at a speed of about 3,000 revolutions per minute.

The tiny motor employs two gyroscopes that are operated by compressed air, steam or gasoline, and give the piston two impulses per revolution. During the show hundreds of persons had the decidedly novel sensation of holding between their thumb and forefinger a motor that was developing one horsepower.

SUBMARINE VENTILATION

The recent sinking of British submarine *A-7* with the loss of all on board has stimulated invention. One of the difficulties in such disasters is to locate the sunken vessel before the air supply in the submarine gives out. The use of compressed oxygen or of sodium peroxide which releases oxygen when wet and

The Engine of a Motorcycle Being Put to Good Use During the Wintertime When the Roads Are Not Favorable to Motorcycling.

By Means of the Glass Covered Solar Heater Placed Over the Side Entrance of This Home, Warm Water Is Secured for Washing an Automobile. The Heat of the Sun Is Utilized for This Purpose.

in turn absorbs all the carbon dioxide generated by the crew, is an excellent safeguard, but the best seems to be the recent invention of Albert Lamy of Havre. A hollow globe is connected with the hull of the submarine in such a way that it can easily be detached in case of accident. The globe then rises to the surface, carrying a hawser. This makes it possible for the rescue crew to pull a flexible tube to the surface and pump through it the needed fresh air. In addition, the floating cylinder indicates to rescuers the position of the sunken submarine.

SUN'S RAYS HEAT WATER FOR WASHING AUTOMOBILES

Warm water to wash a motor car can be supplied by solar heat for about eight months of the year in the east, and all the year round in the south and southwest. In California many garages are equipped with devices similar to the one on top of the structure shown in the accompanying view, and not only is plenty of water of almost boiling heat secured for the cleansing of the car, but a sufficient quantity for bathing and other domestic purposes is supplied with no cost beyond that of the installation of the outfit. The solar heater consists of a pipe coil in a glass covered, insulated box, piped from the water supply and through the heater to the hot water taps. As warm water is far better than cold water for the paint and varnish of the machine, the device is worthy of the consideration of car owners.

WIRELESS COMMUNICATION WITHOUT AERIALS

A wireless society at Tuft's College, Medford, Mass., is at present experimenting with transmitting and receiving apparatus used in conjunction with aerials placed on the ground. According to reports, it is gathered that the aerials in these experiments consist of wires laid hurriedly on the ground, without the use of supports. The best results have been secured with the receiving wire laid in the direction of the transmitting station.

A conservative estimate places the total number of electric lighting companies serving the public in this country at five thousand or more.

To Teach Salesmanship by Motion Pictures

By Charles Alma Byers

PREPARATIONS have been completed to open a department in the Polytechnic High School at Los Angeles, Cal., to teach salesmanship with motion pictures. The course will be inaugurated at the coming school season and will be under the supervision of Prof. George M. Wessells, lecturer of the commercial efficiency course at the school. Two reels of films have been made, showing the right and wrong ways of salesmanship, and under the expense of the Retail Dry Goods Merchants' Association of that city, the films have recently been given a series of exhibitions not only in Los Angeles, but also in several other cities along the Pacific Coast.

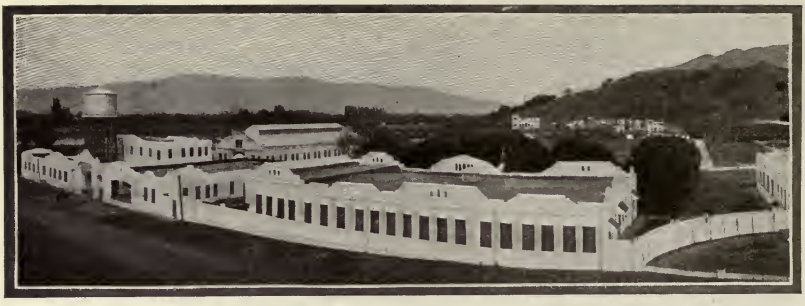
It is a well-known fact that a very large percentage of the boys and girls who go through the elementary and high schools immediately enter some form of employment that requires a knowledge of salesmanship. Heretofore they have been compelled to take up such work without any special training, and therefore, being thus handicapped, the wages they were forced to accept were very low, resulting in the employer often being quite severely criticised. In fact, this phase of the question has probably had much to do with the agitation that has recently become quite general over the matter of compelling department stores to establish a certain minimum wage scale. It shall be the object of this department, with the use of motion pictures, to promote greater salesmanship efficiency and thereby enable the boy or girl to demand a higher wage.

The films were made in Los Angeles stores and portray salesmanship in all lines. First is shown the slipshod manner of the inexperienced salesman and then follows an illustration of how the sale should be properly consummated. They also teach courtesy on the part of the employee, and, in fact, everything else that has a bearing on good salesmanship.

Although the department will be especially intended for all school students who wish to fit themselves for this kind of work, it will be open to every one, regardless of age. And, of course, it will be absolutely free to all. It is claimed to be the only effort yet made to teach salesmanship with motion pictures.

A NEW PROCESS FOR MOTION PICTURE PHOTOGRAPHY

William Foster, superintendent of the Universal West Coast laboratories, announces that his process of colored pho-



A Panoramic View of the Beautiful Buildings at the Entrance to Universal City Where the Motion About 15,000 Inhabitants and Covers an Area of 800 Acres. It

tography, upon which he has been working for the past nine months, is now perfected and that a single reel subject will shortly be produced in which his invention will be given its first demonstration.

The coloring of the picture will take place in the negative and will be printed on the positive just as the regular black and whites are printed. Universal contemplates releasing the first of the new colored dramas in March.

REMARKABLE PHOTOGRAPHIC FEAT

A remarkable double exposure is one of the striking features of "Mother Hulda," the pretentious fairy story production in the Mutual program by Thomas H. Ince. In the picture a great grove of trees slowly disappears, while in its place grows an army of soldiers. Without a cut-back the soldiers advance.

VACANT SEAT INDICATOR FOR PICTURE SHOWS

Patrons of the movies will welcome a newly perfected device that is to be used in moving picture theatres to automatically indicate the positions of all vacant seats. This indicator is formed by a considerable number of small incandescent lamps, contained in a suitable casing, mounted just within the theatre entrance. The lamps are arranged in rows exactly corresponding to the rows of seats, and the rows are combined to form sections between which are provided spaces representing the aisles. Each lamp represents a certain seat, the number of which it illuminates, and at the end of each row of lamps there is provided an illuminated letter identifying the row. The rows of seats are to be similarly identified by letters formed upon glass discs set in the floors of the aisles and electrically illuminated from beneath.

The lamps are all included in separate electric circuits, and the circuit of each lamp includes also a switch mounted beneath the seat which the lamp represents. These switches are acted upon by springs that tend to maintain them open, and further tend to hold the seats slightly raised. When a person occupies any seat, however, it is at once displaced to its proper horizontal position, and the underlying switch is closed.

Thus the indicator lamp representing any seat will remain lit as long as the seat is vacant, but will go out as someone occupies the seat. When movie fans enter a theatre equipped with this device, they will have merely to glance at the indicator lamps to know at once where they may find the best unoccupied seats.

It is probable that the picture show proprietors will be quick to adopt this invention, since it will furnish them with an automatic usher at an expense

Pictures Released Under Numerous Brands Are Produced. This Industrial Community Comprises Has Been Built Solely for the Purpose of Producing Motion Pictures.

much less than would be required for the salary of a real usher. Also it will bring all of the seats into use when the theatre is full of people, keeping them from standing unnecessarily in the aisles.

OFFICIAL OPENING OF UNIVERSAL CITY

One of California's newest cities that is distinctive because of its peculiar mission will enter the field with an exposition during the coming months. The exact date of the official opening is March 15, 1915. The name of the new entrant is Universal City—sometimes known as the "Chameleon City."

Only one industry is pursued in this city which has about 15,000 inhabitants and covers an area of 800 acres, and that is the making of moving pictures. Every man, every animal and every structure is employed in the making of photoplays.

The founder of this strange town is the Universal Film Manufacturing Company. They have installed in this municipality all the latest wrinkles known to motion picture making. They have erected entire villages within this city and have created many odd and strange things that will prove a revelation to its many visitors.

The company is inviting persons going to the Panama-Pacific Exposition to stop over at Los Angeles and visit Universal City. Many big spectacles will be produced for the visitors.

ENORMOUS STAGE ERECTED AT INCEVILLE

That the demand for the productions furnished the Mutual program by Thomas H. Ince is increasing is shown by the erection of a large extension to the already mammoth stage at the Inceville studios. As soon as the great director learned that the stage as then constituted was too small to accommodate the full staff of directors at one and the same time, he ordered the addition. The stage now measures 200 feet by 75, and there is available space sufficient for staging a dozen different scenes simultaneously, while the entire area can be used for staging the biggest single set possible in motion photography today.

BUILDING A SPANISH COLONY FOR THE "MOVIES."

In order to secure Spanish backgrounds for his photoplays, George W. Terwilliger, the Lubin director and writer who is now in St. Augustine, Fla., with a special company of players headed by Ormi Hawley and Earl Metcalfe, is building an old Spanish quarter on the site of the ancient historic buildings that were destroyed by fire last year. The massive coquina walls, arches, windows and doorways of the old buildings are fairly intact, and the Lubin director and his assistants are including these in the new buildings and streets. Not only will the rebuilt Spanish quarter

offer excellent backgrounds for Lubin photoplays, but it will also serve to beautify the city of St. Augustine.

SECURING ANTIQUE FURNITURE FOR A MOTION PICTURE

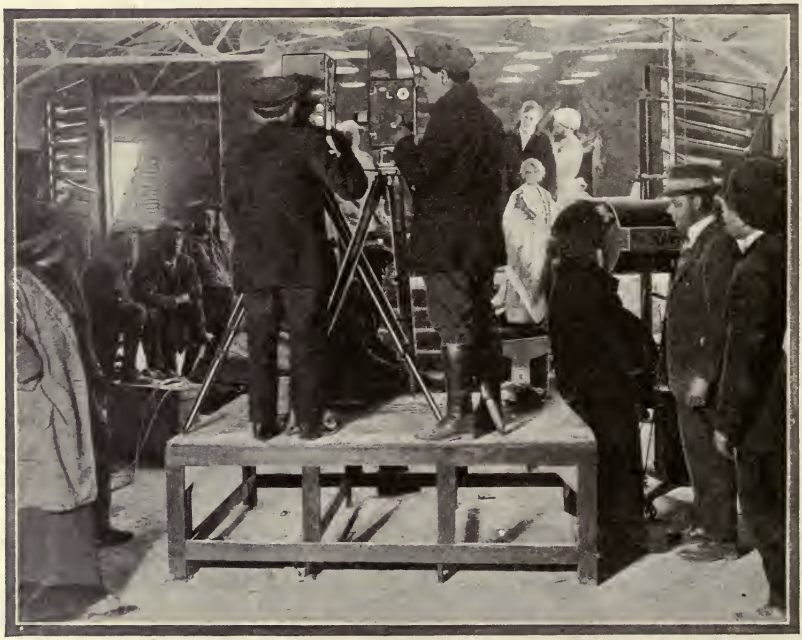
Harry Myers and Rosemary Theby took a day off recently to secure antique Jacobean furniture to dress the wonderful set reproduced in "Cards Never Lie," a two reel Victor drama.

The Victor director and his leading woman roamed Fourth avenue, New York, all morning, then spent the afternoon in curio shops along upper Third avenue and in the higher priced period furniture shops off Fifth avenue.

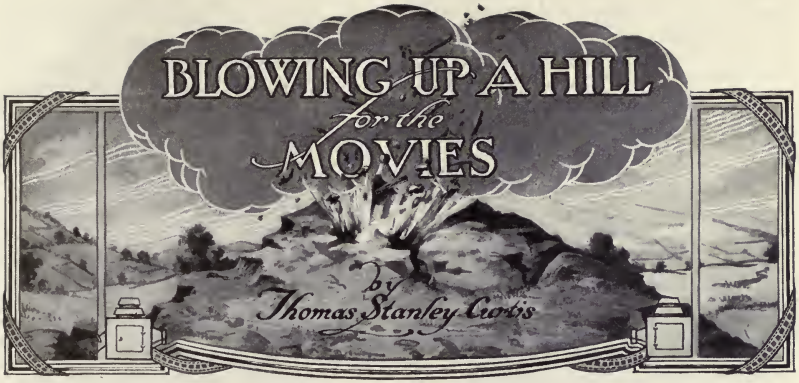
Three van loads of wonderful furniture, all in the Jacobean period, backed up before the Victor studios that night and were filmed the next day.

This is another instance of the expense and trouble the directors will go to in their efforts to secure utmost realism.

FILMING "THE MASTER KEY" SERIAL



In the above view are seen two photographers at work taking pictures of a scene for "The Master Key" serial. The setting in this case is of an oriental character and has been staged in the new indoor studio building just completed at Universal City. The system of artificial lighting comprises three different types of electric lamps—powerful incandescent lamps placed above the set, mercury-vapor tubes located on the sides of the set, and arc lamps mounted on transportable stands.



REALISM in motion pictures is considered a necessity by American producers. Expense and trouble never stand as obstacles in securing the thrillers that go to make a successful photoplay. Here is a typical instance; a carefully constructed house, as well as a hill on which it stood, being blown up for one scene lasting on the screen but a fraction of a minute.

THE signs of what promised to be an ideally crisp, clear day greeted us as we piled into the big touring car purring softly in front of the Thanhouser studio; the kind of day that gladdens the heart of the cameraman as he looks through the studio windows—and which makes him want to throw up his job after he has been out in the cold for hours, as with freezing fingers, he awaits the director's welcome signal, "Camera!"

As we bowled along over the beautiful Mt. Vernon hills, snugly ensconced within a warm covering of fur robes, the inevitable impression of the layman persisted in forming itself in my mind—"pretty soft," as modern slang has it. We see, almost daily, a motor car full of the "movie" folk, smiles on their faces, speeding along, eager to contribute their little bit to the mirror of life, and we are obsessed with the idea that theirs must be a life of never-ending pleasure.

A fairly broad acquaintance among these interesting people and numerous visits to the studios had served to convince me, in a measure, that with the pleasures come many hardships; but it was not until I availed myself of the opportunity to be one of them for a day that I sensed a full appreciation of what it means to be a "movie" man in the field. For downright pluck and gameness, these exponents of the silent drama take the prize. My apologies to the reader for the digression, but I could not resist the temptation to pay a little tribute to these people who suffer untold hardships and who, as a part of their daily work, expose themselves to all manner of bodily risks, and all this to satisfy the increasing demands of an amusement-loving public.

But, as its title implies, this story concerns the staging and photographing of a difficult and spectacular scene, rather

than the vicissitudes of the "movie" actor and actress; it therefore behooves us to return to the theme lest we be accused of wandering off at a tangent.

For many months I had cherished a desire to witness the production of one of the sensational films of the "thriller" variety and when the director of the "Zudora" serial remarked, during one of my visits to the Thanhouser studio, that he intended to dynamite a hill in Episode Five of the serial, the reader may well imagine the alacrity with which I secured permission to accompany the "movie" squad on the following day. To the director, the blowing up of a hill seemed a mere trifle and small wonder for, to a man who sends perfectly good motor cars over cliffs and runs freight trains into expresses, all as a matter of perhaps weekly diet, the detonation of a few dozen sticks of dynamite in a hillside and under a house, would scarcely cause the flicker of an eyelash. To me, however, the episode appeared to be quite an undertaking. The feeling of keen anticipation of exciting times to come was therefore much in evidence as our car neared the spot in a secluded section of Mt. Vernon where the scene was to be staged.

A Veritable Beehive of Activity; Carpenters, Laborers, Explosive Engineers All Contribute Their Share.

A Scene of Intensive Activity

Our arrival at the location disclosed a veritable beehive of activity; carpenters and their helpers rushing lumber up the hill and as rapidly converting it into a small building of very substantial construction; laborers digging great holes in the side of the hill in which the explosive was to be placed; and, overlooking all with a stern and, as it seemed to me, disapproving eye, the city inspector, who seemed to be here, there and everywhere. As a matter of fact, Mr. Inspector was not to be blamed for his very obvious misgivings for, judging from the serious way in which each man carried out his work, and withal, the air of tense excitement, one might have suspected the existence of a conspiracy to blow up the best part of Westchester County!

The "movie" actor in the field is a trained woodsman; so I had been told. I believed it when I saw the businesslike way in which our squad set about finding a sheltered spot for the campfire and believed it some more when I toasted my frozen extremities at the selfsame fire many times during that bitterly cold day.

Within the first hour I had decided that the life of the picture folk was not all honey and roses. The warm fur robes

cease to be warm and Jack Frost has a most provoking tendency to sneak in at the cracks. Even a race to the top of the hill and an undignified slide down its nether side proves ineffectual and in desperation, the smoke of the campfire is braved for the sake of its grateful warmth—which toasts one's face while his back freezes. If the day in the field proves such a hardship to the visitor, what must it be to the scantily clad players?

Laborers Digging Great Holes in the Side of the Hill in Which the Explosive Was to Be Placed.

The Chap with the Camera Seemed as Unconcerned as Though He Were on the Stage of the Studio Instead of Being Propped Up on an Uncertain Stone with an Ugly Pile of Sharp Rocks Fifty Feet Below Him.

A Curious Little Building .... Looked for All the World Like the Bombproof Shelters in the European War Zone.

A Bombproof for the Cameraman

The first tour of inspection revealed a curious little building in process of construction at the foot of the hill. The front and side walls a double thickness of railroad ties, the structure looked for all the world like the bombproof shelters seen so frequently of late in the photographs from the European war zone. An inquiry of a workman elicited the information that the hut was indeed a bombproof built solely for the purpose of sheltering the cameraman whose cheerful duty it was to photograph the hill as it shot skyward not a hundred feet distant. The responsibility placed upon the hut may well be imagined when the reader learns that the country for half a mile around the hill was cleared of visitors prior to the explosion.

The Movie Actor in the Field Is a Trained Woodsman. His First Act on Arriving at the Location Is to Select a Sheltered Spot for the Company Campfire.

In this connection it is interesting to note the subterfuges to which the motion picture companies have to resort in order to prevent the gathering of an undesirable "audience." The news of a spectacular "movie stunt" spreads like wildfire throughout the neighborhood of the location, even though the latter be miles from the nearest house. In the present instance, so quickly had the news spread that it was necessary to place an announcement in the local paper giving a date a day or so later than that on which the pictures were to be taken. A

deeply disappointed crowd undoubtedly awaited results or else turned away in disgust a few days later; but such measures are imperative if accidents are to be avoided.

Filming Under Difficulties

Leaving the bombproof structure, my attention was directed to the top of the hill. The "house of mystery" had been completed by this time and a scene was being rehearsed. A sprint up the hill disclosed the cameraman in process of being let down from above, the camera in his arms and his feet searching for a foothold in the hillside. A friendly rock at last provided the desired accommodation and the heavy tripod was planted. The chap with the camera seemed as unconcerned as though he were standing on the stage of the studio instead of being propped up on an uncertain stone with an ugly pile of sharp rocks at the foot of the hill some fifty feet below him. But the man who would grind the crank while several dozen sticks of dynamite were being exploded within a hundred feet of him would not mind such a mere trifle as the risk of a fifty-foot tumble onto a pile of rocks.

Glancing downward from the cameraman's viewpoint, the hill seemed alive with workmen placing stick after stick of dynamite in the holes on all sides and leading the connecting wires to the blasting machine; certainly this was no place for a nervous man!

An Enormous Cloud of Smoke, Flying Stones, Timbers and Sand Shoots Skyward, and Within Thirty Seconds the Work of Dozens of Men at a Cost of Thousands of Dollars, Goes Up in Smoke.

Ready for the Blast

The scenes at the summit of the hill were finished at last; the "house of mystery" had contributed its little bit to the story of Zudora and all was in readiness for the explosion.

Actors and visitors scamper for the friendly shelter of a wood half a mile

distant; the wires are brought down the hill to the blasting machine and, for a few minutes, absolute silence reigns as George Weber, the cameraman takes his post in the bombproof.

Just to cheer Friend George, Mr. City Inspector peeks through the opening in the log-hut and whispers "My boy, you have just one chance in a hundred to come out of this in a healthy condition." Weber answers merely with an inscrutable grin and shrug of his shoulders and calmly resumes his focusing adjustments.

When the signal is about to be given, a shout is heard and one of the laborers is seen running toward the hill, waving his arms in frantic warning. A glance at the hill reveals a venturesome lad, who has managed to slip past the guard at the rear, leisurely examining the house of mystery, under the floor of which is planted enough explosive to blow it to atoms! While it is doubtful if the youthful investigator understood the precise nature of his danger, he, nevertheless, knew for certain that he was on unhealthy ground, for, within an astonishingly few seconds, we saw him roll down the hill and vanish in a small cloud of dust across the adjacent fields.

This bit of excitement past, and a diligent search for other curious visitors brought to completion, the director gives the word to clear the deck for action.

The signal given, the cameraman begins to turn and the handle of the blasting machine is raised and depressed. An enormous cloud of smoke, flying stones, timbers and sand shoots skyward, followed by a resounding boom; and within a space of thirty seconds the work of dozens of men at a cost of thousands of dollars, goes up in smoke. The scene itself, for which all this preparation had been made, occupied but a few feet of film in the finished reel.

A dash for the spot after the explosion and we find the cameraman calmly packing up his paraphernalia just as though he had finished for the day after taking a series of the most prosaic subjects imaginable.

DICTATING CORRESPONDENCE BY TELEPHONE

The management of a shop which is engaged in turning out all kinds of type-written form letters, circulars, etc., and which furnishes a stenographic service to the public, has introduced what is called a 'phone letter service. Persons practically any distance away may call a stenographer on the telephone, dictate a letter and have it immediately typed as the dictation proceeds, signed with a statement of how received, and posted for the next outgoing mail, all at a comparatively small cost. Special form letter heads are used for this purpose. Many business men have been saved much time by this service. The accompanying illustration shows a girl at her typewriter taking 'phone letters, wearing a telephone headband.

Typist Writing a Letter Which Is Being Dictated to Her Over the Telephone Wires.

The Government built more than three thousand miles of telephone line on the national forests in 1914.

A Storage Battery Tractor Being Employed to Haul Loaded Trailers About a Dock.

A STORAGE BATTERY TRACTOR

One of the latest phases of storage battery application is in the form of a compact tractor intended for hauling flat trucks to and from different departments of large plants or factories, or on steamship docks and in railroad terminals.

The storage battery tractor possesses one distinct advantage over previous vehicles of this kind that were designed to carry the goods instead of hauling loaded trailers, and that is in the reduced initial cost and the low maintenance costs, since there are a fewer number of machines required. While the trailer trucks are being unloaded, the tractor can be hauling other trailers that are ready for a journey.

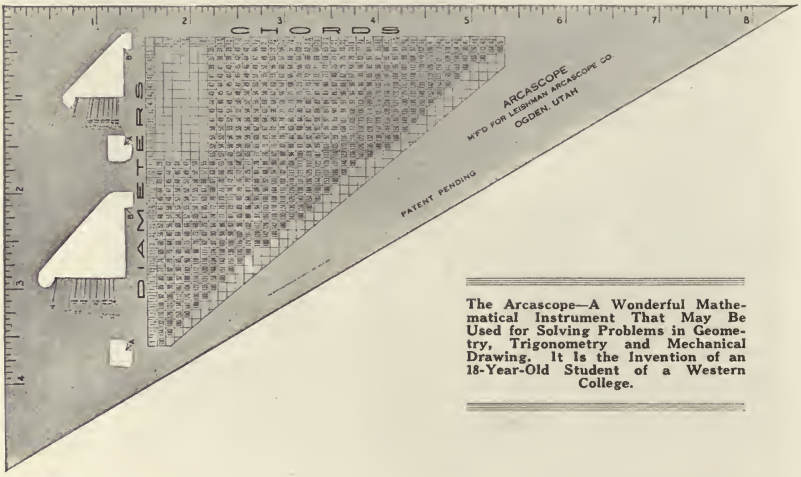
The new storage battery tractor is a three-wheeled vehicle with the power applied on the two rear wheels. The front wheel is used for steering purposes. The tractive power is furnished by a motor operating on storage batteries. An electrical controller permits of four speeds ahead and two reverse, while suitable brakes are provided for the slowing and stopping of the tractor. It weighs about 1,900 pounds and has a maximum speed of eight miles per hour with the average load.

A NEWLY INVENTED MATHEMATICAL INSTRUMENT

A combination rule and triangle that will solve mathematical problems in trigonometry, geometry and mechanical drawing, and which is simple and inexpensive, is the invention of an 18-year-

old boy, Leroy J. Leishman, of Ogden, Utah.

The new device, which the inventor calls the Arcascope, has been attracting a great deal of attention among teachers of higher mathematics in the schools and colleges of the Rocky Mountain states. So valuable do they consider it that it has been adopted in a number of schools.



The Arcascope—A Wonderful Mathematical Instrument That May Be Used for Solving Problems in Geometry, Trigonometry and Mechanical Drawing. It Is the Invention of an 18-Year-Old Student of a Western College.

Students of geometry and trigonometry must include a triangle and a rule in their equipment. The Arcascope is a combination of the two and is small enough to be carried in the pocket. It is triangular in shape, with an eight-inch base and angles of 90, 60 and 30 degrees. The rule extends along two sides. With the possible exception of the sliding rule, the Arcascope is said to be the most compact mathematical instrument ever evolved.

The instrument, in addition to its usefulness as a rule and triangle, will indicate the diameter of a circle when only the arc is given. It will also give quickly the number of degrees in the arc. Given a right triangle, with one side and two angles or two sides and one angle known, it will give all remaining angles and sides the same as though they were carefully worked out by trigonometry. By dividing scalene triangles into right angles as is done in trigonometry, the Arcascope will solve unknown values concerning these. It can be also used to divide circles for mechanical drawings and will work out any practical problem that makes use of the foregoing described principles. Another use to which it can be put is that of determining the distance to an inaccessible point by laying off lines and measuring angles.

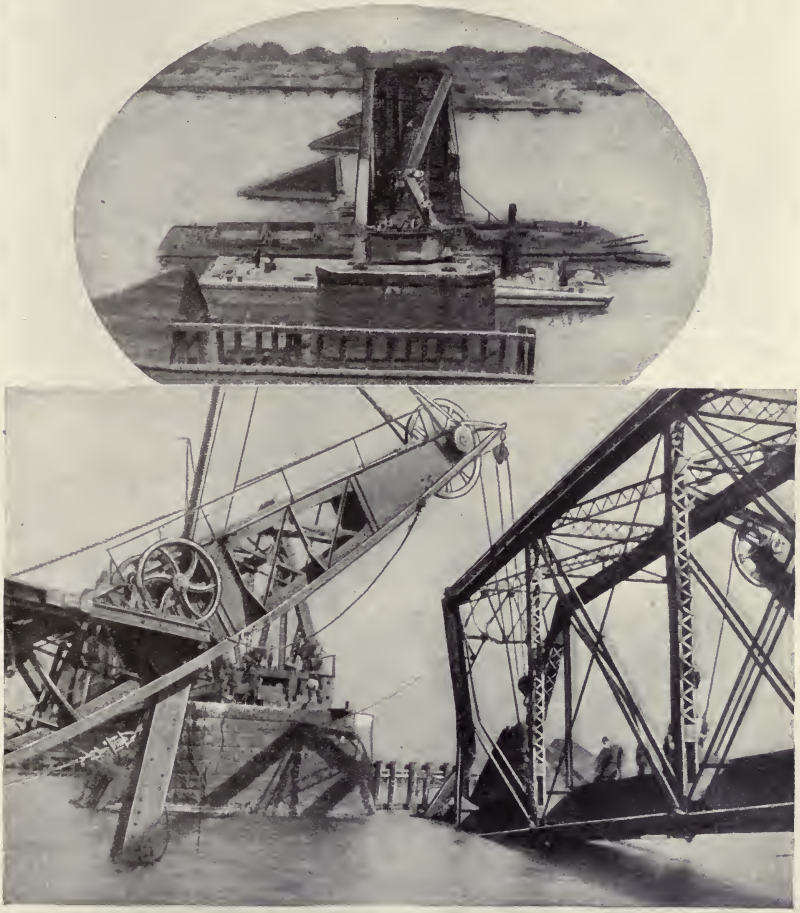
EMERGENCY REPAIRS ON A WRECKED RAILROAD BRIDGE.

The force with which some river barges move is shown by the fate of one of the spans of a Maumee river railroad bridge, which was swept off its foundation and submerged to a depth of twelve feet. Had it not been for some old piling near the ice breaker of the bridge, the span would have been completely submerged.

The problem of lifting the span weighing 210 tons back on to its foundation was solved by the use of two dredges, each having a lifting capacity of 85 tons. While being raised, a flat scow was slipped under the span near one end and,

through the sinking of the scow by blocking it up and pumping out all the water, a second scow was placed directly under the end. The dredges were used to steady the span while it was being raised. At last it was raised sufficiently high to permit of its being slid back on to the masonry foundation. False work was then driven under the span until such time when the damaged steel parts could be replaced.

The foregoing is but a typical example of the many problems that confront railroad engineers. In most instances they display great skill in repairing bridges and other sections of the right-of-way in the minimum space of time to re-establish train service.



Two Views of a Remarkable Piece of Repairing by Railroad Engineers. The Span of the Bridge, Which Was Pushed Off Its Masonry Foundations, Was Put Back Into Place by Means of Two Steam Dredges and Two Old Scows.

A COLLECTION OF SCENES OF THE RECENT SUBWAY FIRE.

Photos. Copyrighted International News Service

Firemen Rescuing Passengers from the Smoke Filled Subway During the Fire That Occurred on January 6th and Which Was Caused by a Short Circuit of a Feeder Cable. In One of the Views Is Shown the Pulmotor in Use.

To Facilitate the Rescue Work, the Sidewalk Grating Over the Subway Tracks Was Removed to Permit of Access to and From the Stalled Trains. Ambulances Were Waiting to Remove Injured Persons Requiring Medical Assistance

THIS is the age of practical men—men who can do things. Schools in different parts of the country are now entering a new era in education; they are encouraging the boys to experiment, as well as make different things themselves. They are pioneers in the learn-by-doing method of instruction.

"THE men who do things worth while are in constant demand," says Supt. R. J. Condon of Cincinnati's public schools; "they will be needed more so in the future than now," he added.

This is why hundreds of boys and young men in Cincinnati are being taught how to do things themselves and not wait until someone tells them how to do it. In a hundred different ways all these boys are working out problems for themselves and accomplishing things just by thinking out the methods unaided.

There is Gordon Fox in the manual training department of one school fixing a new handle on his mother's butcher knife. Some mothers would throw such a knife away and buy a new one, but not so with Mrs. Fox, for Gordon has been taught to repair many things about the house through his training at school. He has been taught to think out for himself how to do things and then proceed and do them. Another boy of the same school brought a porch rocking chair to school to be mended. It needed a new rocker. An oak board at the school supplied just the kind of wood necessary to make a perfectly good rocking chair out of the old one.

This is the way many boys are using their brains and learning how to do things in the mechanical line. But many others are entering the field of research. They are working out problems in chemistry and solving for themselves in the laboratories just what makes plants grow. They are also trying to determine if plants breathe through their leaves and how this is accomplished in winter when no leaves are present. The microscope is opening up new fields for some. The boys are seeing with their own eyes the things which heretofore they learned only from textbooks. They can answer a dozen different questions on a subject because they have learned from self-instruction and observation. It is not possible to trip them up on the perplexing question of how the spider stretches his web across a street, for through observation and a little thinking they solved the problem themselves.

School boys, at least most of them, are always in need of "pin money." To get this necessary cash the boys manufacture many useful articles which find a ready sale. There is one school that has a standing contract for sleds of a type that only its boys know how to

Here Is Little Oscar Kleinschmidt, a Western Union Messenger One Week, During Which He Meets Business Men, and a Student the Following Week. He Is a Member of the Continuation Classes.

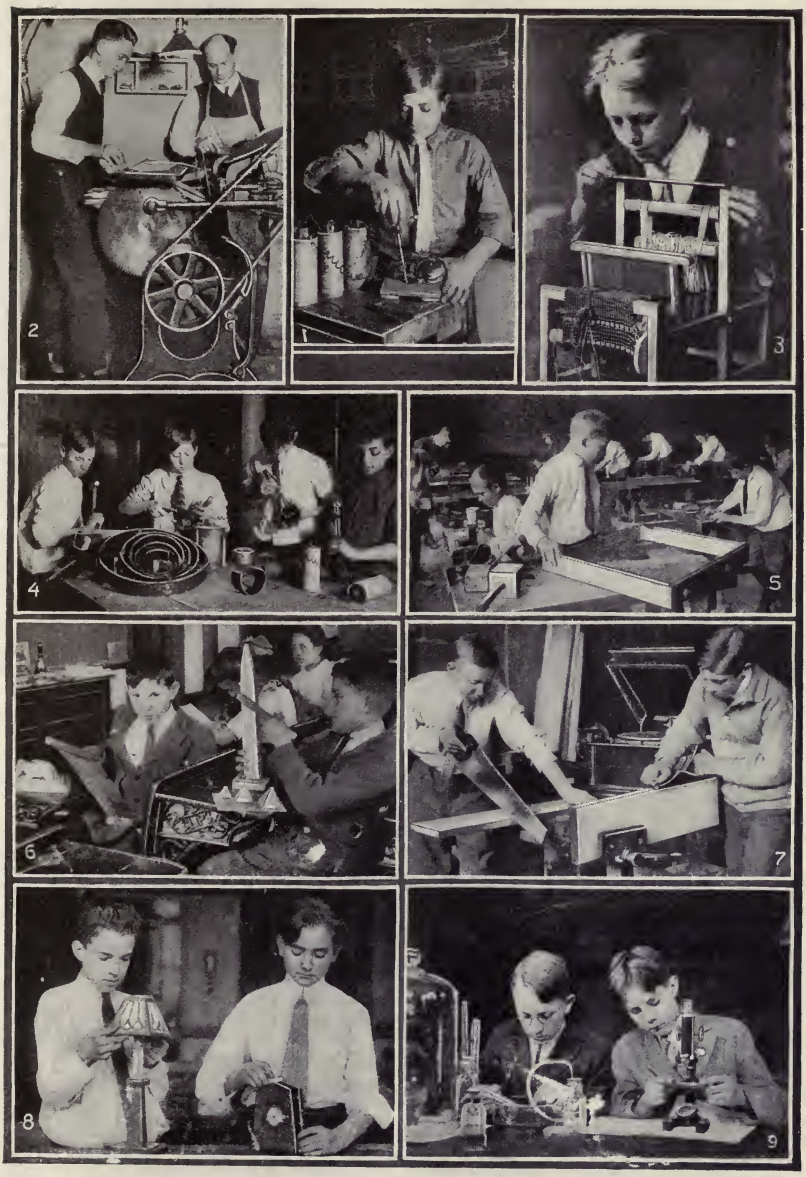
make the parts and put properly together.

Several boys of a Cincinnati school have formed a company, each boy being allowed to acquire certificates of stock according to his industrious abilities. The company manufactures bric-a-brac, lamps, desk inkstands and many other little useful and fancy articles which are eagerly bought up wholesale by various Cincinnati stores. One mother having a boy interested in such work made a purchase at a down-town store one day of a fancy little desk paper weight. She took it home to show her boy how easily he could make some just like it. He examined it carefully for a moment, then turned it over and showed her the company's trade-mark on the bottom. It was a product of this boy's company, at school.

THE VIEWS ON OPPOSITE PAGE ARE: (1) A Student Repairing an Electric Bell. (2) A Student Printing School Announcements on One of the School Presses. (3) A Working Model of a Belgian Loom. (4) A Group of Students Taking Various Things Apart to Find Out How They Work. (5) A Class in Furniture Making. (6) Making a "Dry" Egyptian History Lesson Interesting. (7) Students Making a Phonograph Cabinet — Incidentally Saving the School $25. (8) Two Members of the Boys' Company That Supplies Novelties to Cincinnati Stores. (9) Studying Chemistry and Botany Side by Side.

In order that ancient history studied at another school be more interesting to the classes, the boys are being called upon to furnish the necessary interest in conjunction with lessons about Egypt. Instead of just reading about the pyramids, for instance, boy sculptors are making miniature models of them out of potter's clay and shaping the curious objects of the race as if they were the real articles made some thousands of years ago.

"Boys are not particularly interested in text books which simply tell them things," said one of the teachers. "They become intensely interested, though, if they can work out the things they read about into real objects, or accomplish something as a result of reading that book. A lesson learned that way is



The Various Activities of the Boy Students of the Cincinnati Public Schools. The Boys Are Being Largely Taught By the Learn-By-Doing Method.

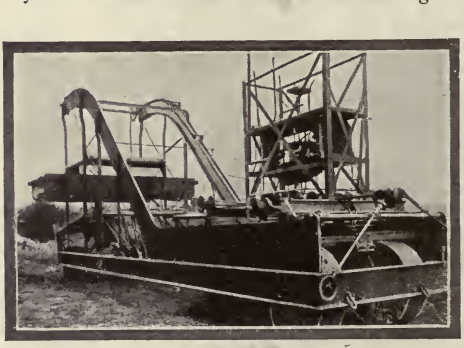
never forgotten," concluded the teacher.

Boy-mind-building, as this new method is known in the schools, is not only making leaders out of hundreds of boys, but it is also making alert students; difficult problems, history and geography lessons are solved much more readily by these young men who are being trained to think and do things, than by those boys who lack the mind-building training. That the training is making valuable men out of these boys may be gleaned from the fact that, when one of these students is forced to leave school at an early age and seek employment, his employer invariably places him on the continuation plan, that is, the boy works a week then goes to school a week, yet he is paid for full time.

It may be considered a certainty that other cities will soon follow the example set by the Cincinnati schools. The value of teaching boys by actual experience has long been known, although, curiously enough, not applied in schools to any great extent.

NEW MACHINE PLOWS AND HANDLES DIRT

In the accompanying illustration is shown a new machine that is designed for handling dirt to be used for grading, as well as loading dirt into dump-wagons. The principal parts of the machine are a gang plow and scraper. There are seven plows that plow an equal number of furrows measuring from six to twelve inches in depth. The scoop handles two cubic yards at each load. The motive power for the machine is furnished by a large traction engine that is equipped with a winding drum. The cable on this winding drum at its free end is attached to a suitable form of anchor which is placed a considerable distance ahead of the machine, in the direction that it is to travel. As the winding drum turns, the cable is wound on and the vehicle is pulled forward. No power is applied to the wheels for the tractive effort.



A Machine That Plows a Field and Deposits the Dirt Into Wagons.

The machine handles a complete load of dirt in twenty seconds and it is said that it will average from 800 to 1,000 loads per day; the dirt being dumped into the usual wagons.

THE SIMPLON TUNNEL

The Simplon Tunnel is the longest tunnel not merely in Europe but in the world, its exact length, inclusive of the two short curves at either end, being 12 miles 537 yards. For about fifty years before its piercing, engineers had been speculating as to the possibility of such an undertaking. By 1898 work was actually begun, and the whole tunnel was ready for traffic by May 19th, 1906. The cost amounted to 2,940,000 pounds, or about $14,700,000.

The north portal of the Simplon is about one mile from Brigue Station, in Switzerland, and the south portal about half a mile from Iselle, in Italy, the frontier being crossed in the tunnel itself. More than half of the tunnel is in Italian territory.

The Simplon is the lowest great Alpine tunnel, the highest elevation reached by it being only 2,313 feet. It was originally built with a double gallery, con-

nected by cross shafts every 220 yards, the two galleries being 56 feet apart. One gallery alone was at first finished, and only a single track laid. The second gallery, however, will soon be completed and ready for traffic.

During the construction of the Simplon the workmen suffered intensely from heat, owing to the number of hot springs tapped and to the temperature of the rock. The thermometer at times rose to 127° Fahrenheit, and the arrangements for ventilation by means of the continual introduction of fresh air proved insufficient, so that the air had to be cooled in advance of the boring party by being sprayed with ice cold water.

The enormous weight and stupendous pressure of the mountain overhead was sufficient to distort the strongest wooden beams and warp the most solid iron supports.

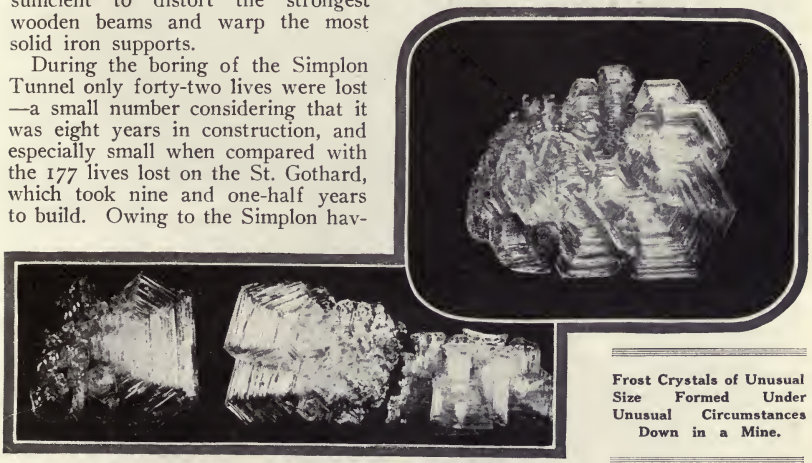
During the boring of the Simplon Tunnel only forty-two lives were lost —a small number considering that it was eight years in construction, and especially small when compared with the 177 lives lost on the St. Gothard, which took nine and one-half years to build. Owing to the Simplon having been begun after considerable experience of great Alpine tunnels had been acquired, it was far more rapidly constructed than any of its predecessors.

The traction in the tunnel is electric, trains taking from twenty to twenty-five minutes to pass through.

Half way through the tunnel, at a point where there are 7,000 feet of mountain overhead, a station has been built, not for passengers but for signaling purposes, two railway officials being constantly kept there. At this station, also, a slow train can be shunted on to a siding, in order to allow an express to pass. So well supplied is the Simplon Tunnel with fresh air that the men in the central station can remain on duty for eight consecutive hours without feeling any ill effects.

HIGHLY DEVELOPED FROST CRYSTALS

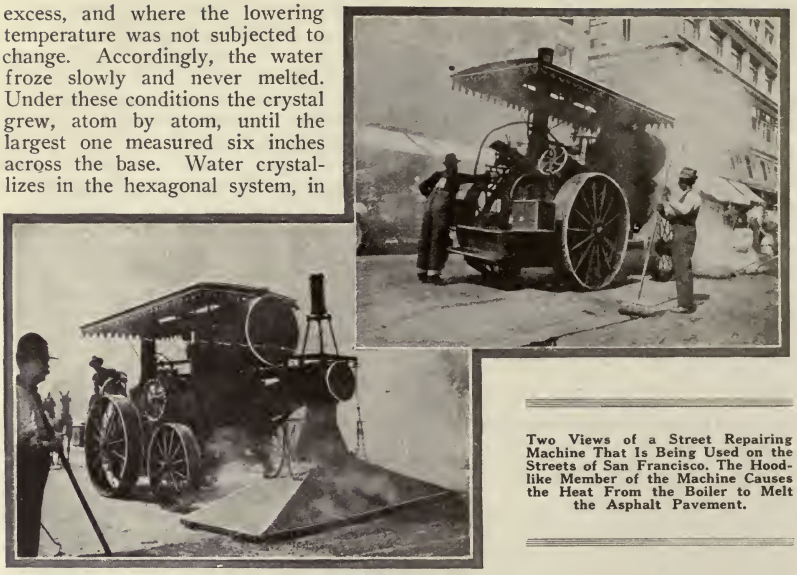
The accompanying illustrations show frost crystals formed under conditions which have permitted them to grow to sizes quite unusual in ordinary life. Tiny crystals of snow and ice are common enough, but their size, usually microscopic, has prevented most people from becoming familiar with their wonderful variety and extreme beauty. Each flake of snow is a complex structure built up upon a basis of a geometrical figure, perfectly symmetrical and adorned with multiplications and changes upon the parent figure. Sometimes they can be seen, especially when the flake is large and is caught upon a piece of black cloth, but one must be earnest in searching before the snow melts and a drop of water takes its place.



Frost Crystals of Unusual Size Formed Under Unusual Circumstances Down in a Mine.

The large crystals shown in the illustrations were formed deep down in a mine where the moisture was not in great

excess, and where the lowering temperature was not subjected to change. Accordingly, the water froze slowly and never melted. Under these conditions the crystal grew, atom by atom, until the largest one measured six inches across the base. Water crystallizes in the hexagonal system, in which there are four axial planes of symmetry. The beautiful regularity of the six sides are to be seen in the illustrations.



Two Views of a Street Repairing Machine That Is Being Used on the Streets of San Francisco. The Hood-like Member of the Machine Causes the Heat From the Boiler to Melt the Asphalt Pavement.

A NEW STREET-REPAIRING MACHINE

The two accompanying views show a new machine that is being used in San Francisco, Calif., for the purpose of taking up asphalt pavement. Its operation is quite a contrast to the usual and laborious method of pick and crowbar.

In general appearance the machine is very similar to a steam roller, although it is not near as heavy and travels at a much slower speed. The fuel used in driving the machine is crude oil. When the vehicle is in motion the chimney in the rear is used for furnishing the draft. On the other hand, when the machine is working, the draft is shut off in the chimney and is forced instead through the funnel at the front by means of a jet of steam. After three or four minutes the flames that have been forced under the funnel, melt or soften the asphalt so that it can be scraped into piles with saw-toothed hoes. The new asphalt is then laid down and rolled out.

By the use of the new machine two to four blocks of street pavement a day can be torn up and relaid, according to the amount of traffic there is on the street.

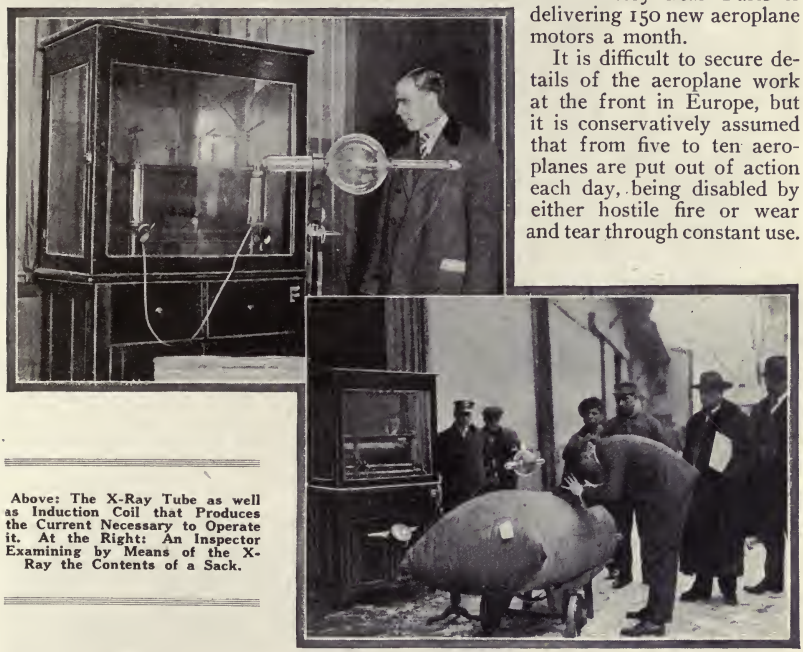
POWER OF AUTO CLOSES WATER MAINS

Through the invention of a New York man, the power of an automobile is now used to open and close big water valves. All manual labor is dispensed with, and the time required has been reduced to a few minutes where formerly from one to two hours' time was necessary.

The new equipment consists of an arrangement that is placed over the manhole in the street. This arrangement is connected by suitable shafting to the rear wheel of an automobile. The automobile wheel is jacked up from the ground. The shaft connection is so constructed that it may be adjusted and clamped on any sized automobile wheel.

USING THE X-RAY TO EXAMINE SHIPMENTS TO EUROPE

An X-ray apparatus is now being used to examine all bulky shipments exported to the fighting countries of Europe through the port of Boston. In this manner any attempt to conceal contraband articles in bales of cotton or similar packages is frustrated. By using the X-ray it is possible for the inspectors to examine boxes, bundles and bales without the necessity of opening them, not only effecting a great saving in time, but also causing the inspection to be more thorough.



Above: The X-Ray Tube as well as Induction Coil that Produces the Current Necessary to Operate it. At the Right: An Inspector Examining by Means of the X-Ray the Contents of a Sack.

The latest available statistics indicate that there are 14,152 telegraph stations in England. Last year's telegraphic business amounted to 87,000,000 messages. The telegraph lines in England are owned and controlled by the Government.

MILITARY SERVICE RAPIDLY WEARS OUT AEROPLANES

The life of aeroplane motors in use is not over 350 hours, and to assure this much of them they must be taken apart, cleaned and remounted every 50 hours, according to the experience of French aviators since the war began. Since the cost of one of the motors, when ordered in lots of 100, is 15,000 francs (about $3,000) each, the expense is a heavy one. One factory near Paris is delivering 150 new aeroplane motors a month.

It is difficult to secure details of the aeroplane work at the front in Europe, but it is conservatively assumed that from five to ten aeroplanes are put out of action each day, being disabled by either hostile fire or wear and tear through constant use.

The military aviation schools are training many hundreds of young aviators, so that there is a constant renewal of the human material at the front, while factories are working day and night to steadily increase the number of aeroplanes in action. Although the cost of maintaining the aeroplane fleets is high, it is comparatively insignificant compared to the money expended for other purpose, notably the cost of ammunition and that of food.

The Making of Olive Products

By Charles Alma Byers

OLIVES have been grown in the United States, almost exclusively in California, for one hundred and forty-five years, but only during the last few years has their culture assumed anything like the proportions of an important industry. The crop now yields an annual income of more than two and a quarter million dollars.

These Revolving Stone Wheels Crush the Olives.

The slow development in the industry has been due mainly to the rather crude and expensive methods in vogue for a long time for preparing the olives for the market. Recently, however, a great deal of attention has been given to this matter, and at present the packing companies of California are far in advance, in methods and machinery, of the olive-growing countries of Europe. At the same time our methods are far more sanitary. During the last ten years, according to government statistics, the output has increased nearly 400 per cent.

The two varieties of olives principally grown in California are the Mission and the Manzanillo, the former being the more popular. Both are used for either oil or pickling purposes. The ones used for pickling must be larger, and these are usually produced on the better land or where fewer trees are planted to the acre. About 60 per cent. of the crop is used for making olive oil.

The first quality of oil is pressed from fruit which is firm yet ripe enough to allow the pit to be squeezed out without carrying with it any of the flesh. When gathered, the olives are spread on drying trays which are then piled up with an air space between so as to dry them out. The olives when drying lose sometimes as much as half the weight of the fruit as taken from the tree. When they feel spongy and greasy they are taken to the mill where they are crushed, usually in a stone trough in

Spreading Out Olives on Trays in Order to Dry Them.

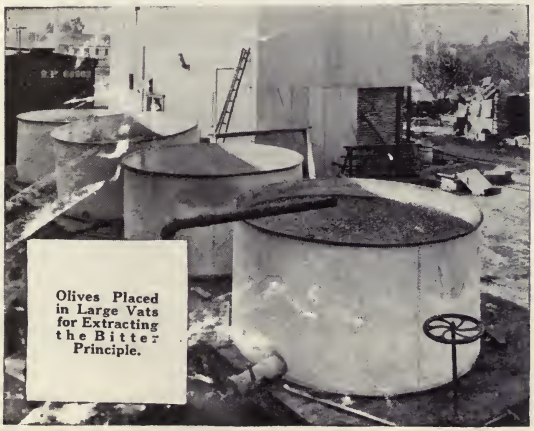
which a big stone member revolves on its edge in the manner of a heavy wheel. After the fruit has been crushed it is put in bags of linen or other suitable coarse material and subjected to tremendous pressure. The resultant fluid is run into settling tanks, where the oil and water separate. The oil, rising to the top, is drawn off. It is still further purified by being pressed through filters of cotton batting; then again through druggist's filtering paper, after which it is ready for bottling.

The process is quite slow, but the oil is absolutely free from any sediment or matter which would cause it to ferment or become rancid. It has taken about ninety days to do this. Every minute of the time the product has been under the constant care of experts and has not been allowed to come in contact with anything which is not scrupulously clean or sanitary.

As the Olives Move by on a Continuous Belt, the Women Sort Them According to Size.

For pickling, olives are gathered in four stages of ripeness: First, green; second, when just beginning to take on a reddish cast; third, ripe, or just when they have become black; fourth, dead ripe. Fruit which has become dead ripe is considered best of all, but it requires extreme care to preserve it and therefore very little of it reaches the market.

The bitter principle must, in each case, be extracted before the olives are edible. This is accomplished in two ways—the lye treatment and the water process. In curing by the water process, which is the one most used in California, the fruit is put into vats or barrels and covered with fresh water which is either changed daily or kept flowing constantly. It takes from thirty to sixty days or more, according to conditions. After the bitter part, due largely to potash, is eliminated, weak brine is put on the fruit—strong brine would cause it to shrivel. After about a week this is poured off and a stronger brine, in which it remains for two or three weeks, is used. The olives are now ready for the market.



Olives Placed in Large Vats for Extracting the Bitter Principle.

In 1912 the United States consumed olive products to the value of more than $11,000,000, of which only a little more than one-fifth was produced in this country. American olives are also grown in Arizona.

SUCCESSFUL FARMING IN A CAVE

A CAVE in the heart of the Ozark Mountains of Missouri is the unusual spot chosen for a farm by a tired citizen of St. Louis. This odd agricultural venture is no longer a matter of speculation, for the farmer is successfully raising mushrooms, rhubarb and celery, while his profits, bigger than those of his neighbors above ground, are unaffected by drought, cold and other destructive climatic phenomena.

Robert Smith, of St. Louis, was one of the first captivated by the "back to nature" movement twelve years ago. While looking about for a farm in the western part of his home state, Mr. Smith found an attractive 26 acre stretch, beneath part of which lay Fisher's Cave, a large subterranean opening that still bore the claw imprints of the bears which formerly hibernated there. Remembering the profitable use made of caves by the mushroom growers of southern France, the erstwhile St. Louisan determined to test the productiveness of his acquisition.

Preparations for the experiment were simple. He first constructed a 25-foot flat bottomed boat, for his only practicable access was by a small river running through the cave. Then, while his neighbors were digging up weeds and clearing brushwood from their lands, Farmer Smith had to uproot and haul away the stalagmites and stalactites—the salty deposits left by the incessant dripping of water during many centuries. Except for a clayey substance, ochre, which covered part of the walls, the cavern floor was bare limestone, so that the final preliminary activity was to spread a quantity of soil and manure over the ground for planting.

Mushrooms are peculiarly suitable for such a project as the cave farm. The spawn is secured in bricks that are broken up and scattered over the floor surface. From a single mulching and with almost no care, the farmer can harvest a new crop of marketable mushrooms every day for three months. Allowing a brief period for the fungus to attain its full size, Mr. Smith can readily plant spawn three times each year. From this promising start the subterranean agriculturist turned naturally to rhubarb and celery. These are planted above ground, but are later transplanted in the cave. The underground ripening causes an unusually rapid growth; the rhubarb gaining on the average an inch a day in length.

The beginning which Mr. Smith has made with his cave farm shows the brilliant possibilities of this form of intensive cultivation. Besides the crops which the Missouri farmer is now producing regularly, the cave, with its fixed quantity of moisture and its temperature which never varies from 60°, is better than a man-made cold storage house for keeping vegetables fresh indefinitely. So quickly did this condition become evident that all the farmers within a radius of twenty miles now store their sweet potatoes in the cave for periods as long as two years to secure a favorable market.

ELECTRICALLY EQUIPPED KITCHEN

It is only natural for those who have not investigated the cost of cooking by electricity to dismiss the proposition by saying that it is too expensive and that only families of wealth can afford such luxury. Yet, in Tulare County, California, there are 175 consumers on the local company's system using current for cooking and heating.

There is a kitchen in one of the residences in Visalia which is merely a sample of a number of similar installations that have been made in Tulare County. The family using this equipment consists of two people, and they do all of their cooking and heat the kitchen with electricity, in addition to using it for lighting purposes.

At the Top: The Underground River That Flows Through the Cave in Which Is Situated a Farm. In the Oval: The Entrance to the Underground Farm. Below: A Portion of the Subterranean Farm, Devoted to Mushroom Culture.

ELECTROPLATING OF PALLADIUM BY NEW PROCESS

Palladium is now used for the plating of fine instruments in preference to silver, on account of the fact that it is harder and also because it does not tarnish. The bath usually employed is that of Pilet and Carry, of Besançon, France, composed of chloride of palladium, phosphate of ammonium and phosphate of soda. A small quantity of benzoic acid is added to the bath; this, according to the inventors, serving to increase the whiteness of the deposit.

The palladium plating bath is prepared as follows: Take one-quarter of an ounce of palladium in the form of thin leaf and cut it up into small pieces. Place them in a flask and add one ounce and a quarter of strong muriatic acid and an ounce of nitric acid. Heat gently until the palladium dissolves, and pour into an evaporating dish. Evaporate until a pasty brown-black residue is obtained. Now add sufficient soft or distilled water to dissolve the paste, which will produce a dark brown solution.

Wrecking an Elevator by Means of a Cleverly Placed Dynamite Charge.

Now make a solution of half an ounce of ammonium phosphate in 8 ounces of water. Warm and add to the first solution. To this add 8 ounces of phosphate of soda dissolved in two quarts of water. Boil until the solution is clear and all smell of ammonia has disappeared. If it is desired to whiten the deposit, add one-quarter of an ounce benzoic acid. The foregoing accomplished, add one quart of water, which will bring the total amount to about one gallon.

The solution may be used cold, but it is preferable to warm it to about 120° F. A good coating will require from 5 to 10 minutes in the bath, and it may be deposited on brass, copper, iron or steel. Use a carbon or a platinum anode. If the carbon from an old dry battery is used, soak first in hot water to remove the sal-ammoniac. A current of 2 volts is sufficient. Use a porcelain dish, a glass or enameled vessel to hold the solution.

REMARKABLE DYNAMITE BLAST

In the accompanying illustration is seen an elevator shaft 165 feet high being destroyed by a dynamite blast. The railroad authorities recently found it necessary to make way for extensive yards at Phillipsburg, N. J., and accordingly decided to wreck the elevator as well as the old iron furnace shown at the left that was built as far back as 1849.

FORESTRY NOTES

Lodgepole pine, one of the principal trees of the Rocky Mountains, makes good strong wrapping paper and pulp board.

Recent sales by the Government totaling 126,000,000 feet of saw timber in the Olympic national forest, in western Washington, mark the opening of this hitherto inaccessible storehouse of timber, estimated to contain a stand of 33,000,000,000 board feet.

At least 25 per cent. of the larch timber over large areas in eastern Oregon has been killed or weakened by mistletoe, and the forest service is taking steps to combat the pest.

DESIGNING WARSHIP HULLS by EXPERIMENT

By Robert Hunt Moulton

ON the water of the Model Experiment Basin at the Washington Navy Yard, each new vessel of the United States navy is tested before construction by means of a toy reproduction possessing the exact lines and proportions of the large craft's plan. Costly errors in warship construction are thus eliminated. And often a great saving in cost is effected through the knowledge gained in the tests.

YOU have taken a patriotic pride in the speed performances of American fighting ships, and if you have followed these showings closely you have no doubt been impressed with the steady advance made. Each year naval vessels have shown consistent improvement in speed, seaworthiness and engineering economy, but have you ever paused to ask how these results are primarily made possible? This is the direct fruit of the model experimental basin.

The model tank, as it is generally called for brevity's sake, is the establishment in which small models of prospective ships are made and tried on a reduced scale. When Congress was asked to appropriate money for the plant which is now an interesting and important department of the navy yard at Washington, the proposition was looked upon as involving an expensive toy. Since then, however, the work done there preliminary to the building of warships has represented a saving of many hundreds of thousands of dollars, besides insuring the designed performance of the man-of-war.

This is another example of the old rule of thumb being supplanted by the certainties of science. Without going too far into the history of things, it is sufficient to know that an Englishman, Dr. William Froude, discovered back in the '70s that there was a comparable relation between the power required to draw a small model through the water and the motive energy needed to propel a big craft of similar form. The principle which he discovered later became known as Froude's law, or the law of comparison. His studies were first made with miniatures and then verified by the towing of a large vessel formed on identical lines.

Within the last twenty years there have been created and developed many vessels of novel types and the results obtained would have been virtually out of the question but for the model tank. Millions of dollars would have been wasted in blind groping instead of ob-

taining positive assurance of what the finished vessel would do before a single cent was spent in her building.

All of the models tested at Washington are of a uniform length of twenty feet, and the purpose of making them so large is to reduce the possible error in translating the performance figures of the model into those of the full sized vessel. These models are made of wood and are fashioned in a machine especially designed for this work.

Next, the model is painted and carefully varnished, in order to obtain a very smooth surface; and with this done various waterlines are marked upon the white paint, so that instantaneous photographs taken during the towing tests will show just how and where the waves and the hollows produced by the miniature boat in motion are developed.

When the model is ready it is carried to the basin and there loaded in the balancing tank with bags of shot until it has the right weight or displacement and proper trim or poise upon the water. With this done it is ready to be attached to the towing carriage and tested.

The towing carriage is a sort of mobile bridge which straddles the main tank. It is driven by electricity, the different speeds being under very nice control. Upon the towing carriage are all of the operative switches and measuring instruments, as well as the recording mechanism which marks the speed of the model and its pull or resistance when drawn through the water. The aim is to obtain a ship form which will show the least pull or resistance at the desired maximum velocity. The actual speed of the model is a mathematical ratio of the relation between this miniature and the full sized ship, and therefore the model does not travel fast, if you consider what the big craft will really do.

The towing basin is 370 feet long and 43 feet wide, and the maximum speed of the carriage is relatively far in excess of the probable speeds of anything but freak craft.

After a model of satisfactory form has been developed and tested, then comes the further task of making the figures of the trials applicable to the battleship which is to be built.

Now there is just one part of this work which does not follow Froude's law of comparison. This is the factor of the friction set up between the water and the wetted surface of the vessel's underbody. This resistance follows a law of its own and it is necessary to tow another model which consists of a thin plate just as long as the small craft and with a submerged surface exactly equal to that of the model.

From these two tests, that of the plane and that of the model, the designer has the information he wants and this information covers various trials over a wide range of speeds, so that the naval architect knows both the maximum and the cruising speeds at which the vessel can be propelled most economically. The cruising speed is an important one, because it is at this rate of travel that ships of war go most of the time. Full speed is really a battle reserve or something to be called for only when urgency demands. In this particular, fighting ships differ radically from the ocean greyhound of commerce.

But don't think that the naval designer has an easy task even with the model tank at his disposal. The speed trials of the full sized ships are not less important to him because they give him a check upon his model work. This check is very necessary inasmuch as it enables the designer to bridge over the gap between his model and the real vessel year by year with more exactness.

The builder of the hull structure, the naval architect or naval constructor, has only a share in the final product. The naval engineer must take up the problem where his brother ends. That is to say, the engineer knows just what energy his propellers must exert effectively against the water in order to force the ship along at her several speeds. He, too, must work from the outside of the ship inward up to a point.

The position of the propeller in relation to the hull and the very form of the propeller must be suited to the particular craft in question. These can be tried in miniature in association with the model for the determination of some data, but after that the engineer must

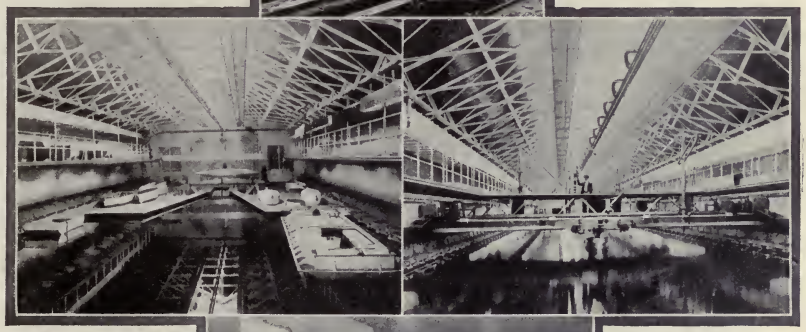
draw upon experience and his carefully tabulated records of other performances.

The average annual expenditures for the maintenance of the model basin at Washington are under $25,000, and this is a trifling sum compared with the savings which have been effected through careful designing. In the case of the three scout cruisers *Birmingham, Chester* and *Salem,* by merely lengthening their hulls it was found possible to save in those three ships a combined total of 17,000 horse-power over that required for the original design. Figured at $60 a horse-power this represented an economy of machinery cost amounting to $1,020,000.

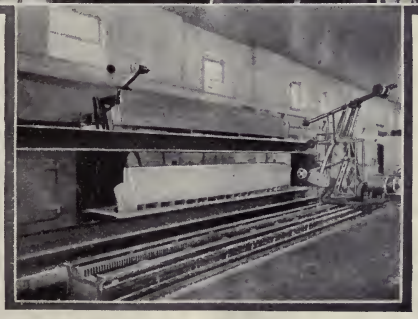
The model experimental basin is no longer looked upon as an investment of doubtful value; every first class naval power has one of these establishments, and like that at Washington most of them lend their aid to the merchant marine as well. Such is the development of the experiments of Dr. William Froude.

At the Right: A Close-up View of Part of the Machine That Is Used for Modeling the Miniature Hull.

Below: The Electric Towing Carriage in Motion With a Model Hull Attached to It for Testing Purposes.



Above: One End of the Test Basin Showing a Number of Miniature Hulls to Be Tested.



At the Left: Another View of the Machine That Makes the Hulls. The "Former" Is Below and the Model Above.

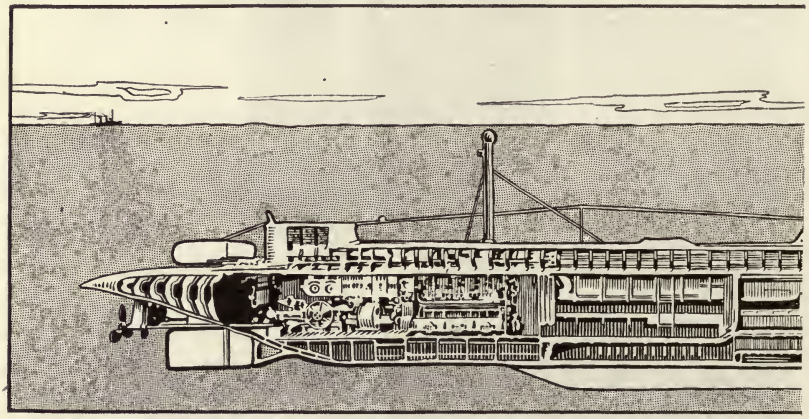
GERMAN SUBMARINES AND THE WAR

THE partisans of the submarine torpedo boat have been very much encouraged by the manner in which these under-water craft have made good in the present war. True, they have not worked all the wonders in naval combats that have been so confidently prophesied by their designers, but it must be borne in mind that this order of torpedo boat is still in its extreme youth; yet, when conditions favor its operations, it is capable of dealing a death blow to the mightiest of dreadnoughts.

Although much has been said of the dire work of the "U" boats of the German under-water flotilla, it is necessary in all fairness to give credit to the rival British craft for setting the offensive pace. It was British submarines that made their way to the Bay of Heligoland and lured the German cruisers out from under the protecting sweep of the formidable guns mounted on the island of that name. But the presence of the British subaqueous torpedo craft served then to bestir the Kaiser's "U" boats to vengeful activity, and they have been destructively busy at intervals ever since. The most amazing feature of these performances on the part of the German under-water flotilla has been the sureness of their attack and their capacity to operate at extremely long distances from their bases.

Strange as it may seem, it was not so many years ago that the great German naval organizer, Admiral von Tirpitz, vigorously opposed the building of submarines, and yet to-day he is putting these very craft to the most telling service. The truth of it is, he was strategist enough to wait until other nations had paid the price of developmental work, and then, with certain engineering difficulties surmounted, he saw to it that every mark spent by his government should make for the effective strength of the navy. But his change of heart was hastened by revelations which came during the grand naval manœuvres in the autumn of 1912.

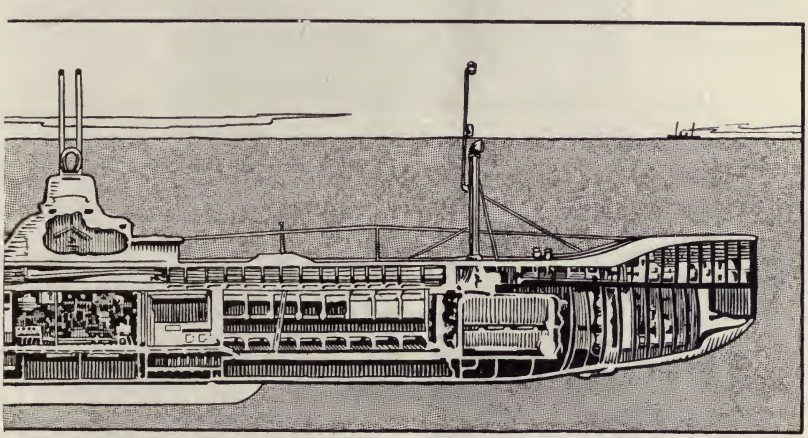
In those operations, the under-water craft performed in an unexpectedly brilliant fashion, and their behavior opened the eyes of the Kaiser's naval experts. The fine seafaring qualities of the "U" boats and the ease with which they succeeded on several occasions in surpris-



A Cross-Sectional View of a German Submarine Boat of Most Recent Design. A Craft of This Kind Equipped With Four Torpedo Tubes and Two 14-Pounder Quick-Firers, and Carries a Crew of Probably Electric Motors and Gasoline Engines; Ventilator, Escape Hatch and Men's Quarters; Captain's Cabin; Escape Hatch, and Ventilator and Torpedo Tubes. Along the Bottom of the Submarine in Their Relative

ing and "torpedoing" certain of the big ships duly impressed the admiralty officials present at the war game. The boats were able to manœuvre with great precision when totally submerged, and were so handled that they came to the surface at exactly the right distance from the ship to be attacked—this range seldom exceeding 400 yards! This meant certainty of hitting with an actual torpedo.

Again, the North Sea prior to the war had been the favorite field for exercise, and the submarines were frequently sent from the mainland to Heligoland and back when the sea conditions were calculated to try both the boats and their crews to the utmost. Now here is an item that explains still better why the "U" boats have scored as they have. A rival naval expert tells the story. "One day towards the close of the manœuvre period the weather was bad, so bad, in fact, that the smaller destroyers were unable to do their part in the programme and had to run for shelter. A division of big cruisers belonging to the 'blockading fleet' were patrolling some twenty miles off shore and keeping a sharp watch for one of the opposing battle-cruisers which was expected to make a dash for the open sea. In view of the boisterous weather no one gave a moment's thought to torpedo attack, and a good many people on those cruisers got the surprise of their lives when half a dozen submarines bobbed up so close to them that torpedoes could not miss, and made the ominous signal that all four ships concerned were torpedoed. This was not an isolated case during that interval of mimic warfare; and the Germans found the submarines to be less dependent on mother craft than the ordinary surface torpedo vessels, and much less liable to mechanical breakdowns. No wonder that the German submarines have done so well in actual conflict."



Courtesy *The Illustrated War News.*

Has a Displacement of About 900 Tons, a Surface Speed of 18 Knots and 12 Knots Submerged, Is 30 Officers and Men. Briefly, the Sections of the Vessel From Left to Right Are: Engine Room, With Conning Tower, Periscope and Central Operating Department; Officers' Quarters; Torpedo Room and Order Are: Lubricating Oil Tanks, Storage Batteries in Two Separate Compartments, and Oil Storage.

There has recently been demonstrated at Ilion, N. Y., by a well-known typewriter company an electrical typewriter which, it is claimed, will revolutionize the transmission of messages over telegraph wires. The demonstration showed how an operator writing on one machine would simultaneously cause another similar machine to write at a remote place. A speed of 60 words per minute was easily obtainable.

HOW AN INVENTOR SECURED CAPITAL

An inventor of limited means who had not sufficient time to devote to capitalizing his invention secured funds by this odd method: A working model of the invention was loaded upon a push cart and wheeled to a vacant lot in in the center of the city. It was possible, as a rule, to get permission from the foreman of a building job to leave the model near the sidewalk for a day or two with no other charge than one or more cigars. The model carried a brief description and the owner's name and address, together with a statement that capital was needed to float the device. Meanwhile the inventor was able to go about his daily work that brought in a living while waiting for funds to promote the device. The results are said to be successful and it was certainly an inexpensive advertising campaign.

A Western Inventor Secured Financial Aid by Displaying His Idea to Passers-by.

ELECTRICITY CARRIED THROUGH WATER STREAMS.

In several instances firemen have been shocked by electric currents passing through a stream of water issuing from a hose. It appears that the current passes from a live conductor on which the stream is being directed, through the water to the ground. Upon holding the brass nozzle at the end of the hose, the firemen are apt to receive an electric shock.

The experiments of an Italian by the name of Ugo Tartaglini, described in *La Scienza per Tutti,* are of exceptional interest since they indicate the amount of current flowing through a stream under different conditions. In one test a stream of water from a hose fitted with a nozzle measuring 15 millimeters in diameter was played on a trolley wire carrying a direct current of 525 volts. At 2.2 metres distant a voltmeter attached to the nozzle on one side and grounded at the other registered 20 volts. At 65 centimeters away it registered 70 volts, while at 20 centimeters a voltage of 210 was indicated. Since the average man can stand a current of 50 volts without serious shock, it follows that a fireman can hold the nozzle of a hose five or six feet away from the wires without danger.

Mr. Tartaglini also has experimented in conjunction with alternating current lines, one of these carrying a current of 2300 volts and the other 4600 volts. In both instances a voltmeter did not indicate a passage of current through the stream of water, although the experimenter states that a slight shock could be felt by placing one's hand in the stream.

Chemical extinguishers are the most dangerous form of fire fighting equipment around live wires. With such an extinguisher Mr. Tartaglini noted a current of 1500 volts passing through a stream of water when the nozzle of the hose was placed at 225 millimeters from a wire carrying 2050 volts.

News print paper has been made by the forest service laboratory from 24 different woods, and several compare favorably with standard spruce pulp paper. The great quantities of wood pulp that are being used constantly for newspapers and magazines make it imperative to find substitutes for spruce pulp.

THE cooking of food by means of electricity is a commercial proposition. In order to make it a success, it is necessary to point out the advantages it has over other methods. These advantages may appeal sufficiently to the housewife to give it a trial. The next thing to prove will be its general cheapness. Competition is the keynote of activity in all fields of effort, and the gas companies have carried on so successfully a campaign in the introduction and use of gas for cooking and heating that, in the majority of homes, the use of electricity for that purpose would seem a novelty. The same campaign must be carried on on behalf of the use of electricity. The electric stove is no novelty in the West, in the kitchen, at least. In the East it is gaining ground every year. By its means the housewife benefits in the following manner: First, there is no waste heat, consequently she works in a cool kitchen. Second, absolute cleanliness is possible at all times. Third, labor is reduced to a minimum because an electric stove is always ready. Fourth, with no flame, there is perfect safety. Fifth, the character of the stove permits of more time for social duties. Summing up, therefore, it is evident that an electric stove is safer, hygienically superior, socially more acceptable, and from a labor standpoint a time-saver, as compared with a coal or gas stove. Without dirt, ashes, gases or smell it constitutes an ideal addition to a clean and well kept household. As no oxygen is consumed by it, the air of a home is purer. As it is small, no kitchen is crowded by its use. As it is scientific in construction and operation, it means that the housewife can predetermine results with laboratory-like exactitude in roasting, baking or stewing. Consequently, the phrase "You can cook by the clock" is justified by its use. As the kitchen is really a laboratory in which foods are prepared to excite appetite and induce digestion, it is a splendid thing to realize that the electric stove, the highest scientific product of the age in that field, can be installed to reduce all kitchen operations to a dependable basis. This in itself is a great advantage. The empirical laws that have hitherto prevailed in the culinary art need prevail no longer. One of the greatest sources of failure in baking has been a questionable oven temperature. With the electric stove this cause disappears. With its disappearance the doubts concerning results go too. A housewife prepares her dough according to exact recipes and can feel certain with a guaranteed and regulated temperature that cake or bread will emerge "done." It means working in a modern, sanitary way—the science of housekeeping realized.

THE UNIT OF THE STOVE OR HEATER —The heating unit is a disc, within which is the heating device. The heating is obtained by means of an inoxidizable high resistance wire. This wire is wound around an insulating body, or enameled, or embedded in a non-conducting substance, or otherwise prepared to act as an element of the heat-

ing system. Frequently a steel disc is employed within which the heating element is sealed. The element is brought as near to the side which is to emit the heat as possible. The other side of the disc, that which is not used for heating, is supposed to be provided with a "dead air space." In disc stoves, which are merely steel discs supported on legs, the device is used for heating similarly to single plate gas stoves. As the under part would radiate heat equally with the upper were this not obviated, the air space is provided below. Four-legged units of an oblong form are on the market, constituting electric stoves with appliances. For instance, two tops—a grid used for toasting, and an aluminum griddle plate used for baking griddle cakes; or inverted for frying purposes. It is provided with a cake turner which also forms a handle for the stove and attains a cooking temperature in from three to five minutes after current is turned on. The high resistance wire heated by the flow of current produces a certain number of heat units a minute and if this heat is not radiated wastefully, it can be utilized for the purpose in view most economically.

Electric Water Heating—For instance it may be, and often is, necessary to know the amount of time required to heat a certain quantity of water by means of a certain number of watts. To accomplish this the following formula is needed, giving the minutes required for a certain number of gallons or pounds of water:—

(For gallons of water)—

$$\text{Minutes} = \frac{146 \times \text{gallons} \times (\text{Th} - \text{Tc})}{\text{watts} \times \text{per cent. efficiency}}$$

where Tc = temperature of water cold.
where Th = temperature of water hot.

Allowing an average efficiency for electric cooking devices of from 80 to 95 per cent. or about 85 for all cases would give a definite figure for the formula. In a specific case of one gallon of water to be heated from 40° Fahr. to boiling point or 212° Fahr., about a kettle full of water in all, with a wattage of 2000, the calculation shows the following:—

$$\text{Time} = \frac{146 \times 1 \text{ gal.} \times (210° - 40°)}{2000 \times .85}$$

$$\text{Time} = \frac{146 \times 172}{1700} = \frac{25112}{1700} = 14.7 \text{ minutes}$$

In other words, it will take nearly 15 minutes to boil 1 gallon of water with 2 kilowatts according to this calculation, the efficiency of the cooker being 85 per cent. If the quantity of water is reduced to one-half a gallon, the time required with the same power would be 7 minutes. If the power is reduced to one-half, the time required to heat one-half a gallon of water from 40° to 212° Fahr. would still be 15 minutes.

In cooking, the boiling and stewing processes are similar to those of boiling water, the exception being that the amount of fluid is less. In boiling potatoes or making soup there is a similarity to that of boiling water in the tea kettle. The calculation shows that the time reduces, and therefore the cost in proportion, to the reduction in the quantity of water. For instance, with one gallon of water and 1000 watts the time in minutes required to bring it to a boil is:—

With 1 gallon—

$$\text{Minutes} = 29.4 = \frac{146 \times 1 \times 172}{1000 \times .85} = 4 \text{ quarts}$$

Electric Cooking Has Many Advantages, But One of the Principal Ones is that "You Can Cook by the Clock."

With ½ gallon—

$$\text{Minutes} = 14.7 = \frac{146 \times \frac{1}{2} \times 172}{1000 \times .85} = 2 \text{ quarts}$$

With ¼ gallon—

$$\text{Minutes} = 7.35 = \frac{146 \times \frac{1}{4} \times 172}{1000 \times .85} = 1 \text{ quart}$$

Even a quart of fluid is rather excessive for certain forms of cooking, but assuming it is not, it is evident that a kilowatt need only be used for 7 minutes to reach boiling point. After that point has been reached, a reduced heat will be all that is necessary. The same formula is used for pounds of water instead of gallons, but the coefficient 146 is reduced to 17.5, as for instance:—

(For pounds of water)—

$$\text{Minutes} = \frac{17.5 \times \text{pounds} \times (T - T)}{\text{watts} \times \text{per cent. efficiency}}$$

In a case of 10 pounds of water raised from 40° to 212° Fahr. and 1000 watts used, the time would be, with an .85 efficiency as before:—

$$\text{Time} = \frac{17.5 \times 10 \times 172}{1000 \times .85} = \frac{30100}{850} = 35 \text{ minutes}$$

With 5 pounds of water the time would be one-half or about 18 minutes. In summer the water is warmer when drawn from the faucet than in winter. The gain would be about 20° Fahr. in this respect. According to the last calculation, 1 pound of water would heat up in about 3.5 minutes with the application of 1000 watts. At the rate of 10 cents per kilowatt hour, it would cost about one-seventeenth of 10 cents or .6 cent per pound of the water boiled.

To get the watts required to heat a certain volume of water in a given time in minutes, the device having a certain efficiency, the following transposed form of the formula is required:—

$$\text{Watts} = \frac{146 \times \text{gals} \times (T - T}{\text{minutes} \times \text{per cent. efficiency}}$$

If we wish to heat two quarts of water and take ten minutes doing it, bringing it to the boiling point, the power required will be as follows, the "½" meaning two quarts or ½ gal.:—

The Character of Electric Cooking Permits of More Time for Social Activities.

$$\text{Power} = \frac{146 \times \frac{1}{2} \times (212° - 40°)}{10 \times .85} = \frac{12556}{850} = 1477 \text{ watts}$$

According to these figures it will take about 1.5 kilowatts for 10 minutes to heat ½ gal. or two quarts of water to the boiling point. At 10 cents per kilowatt hour, it will take 1½ kilowatts for 1/6 of an hour. This will mean 1/6 of 15 cents or 2.5 cents cost. As the efficiency of a heating device is really a measure of its non-radiative power, it is evident that the less the radiation, the less the wasted heat and the higher the efficiency. The higher the efficiency the less the cost in service. The radiation is dependent upon the construction and the surface of the electric heating utensil. The greater the surface, the greater the radiation; and the less the surface, the less the heat wasted. The facts are as follows:—

(a) For polished nickel or copper vessels the loss is 1 watt per 250 square inches per degree Fahr. rise.

(b) For tarnished copper, iron or dull surfaces the loss is 1 watt per 150 to 175 square inches per degree Fahr. rise.

ELECTRIC COOKING RANGES — The commercial fact to be ascertained is the cost of cooking by an electric range. In one which is well equipped, there is a separate switch for an 8-inch stove, a switch for a 6-inch stove, a switch for the oven, a switch used in changing from oven to broiler, another switch for a 6-inch stove and a final switch for a broiler and toaster. It is always economy to turn the heat on full until the stove or oven or broiler is hot. After the cooking begins the medium or low heat may be used to continue the operation, but it is not economy to use them at first. In electric ranges the best practice is to use vessels that lock on, as by this means the heat is not wasted as with ordinary utensils. Another practice is to have three degrees of heat governed by a controlling switch. This aids in the use of a heat suited to the cooking and is obviously otherwise economical. The cost, as given by one large manufacturer of electric ranges, is from 3 to 5 cents a day per person. In places where special rates are given to those installing cooking or heating devices, the cost would be less. It seems likely that with the more extensive use of electric ranges, central stations will give special rates for the reason that this would add to the day load, a time when the call is least for power for lighting. In the case of one particular range, from whose operation data is supplied as to the cost of cooking various meals, the total watt consumption, with every receptacle in use, is 3775 watts. The parts of the range and the individual watt consumption of each part is given, as well as the capacity of the vessels adapted to this particular type.

Electric Cooking Stands for the Minimum of Help in the Household.

		Costs.
(1)	Oven, 12 inches deep, 11.5 inches high inside, takes 1,300 watts at 10 cents per K.W. hour.....	.13
(2)	Broiler, 9 × 12 inches, with griddle top, takes 1,300 watts at 10 cents per K.W. hour.....	.13
(3)	Disc stove, 8 inches in diameter, takes 735 watts at 10 cents per K.W. hour	.073
(4)	Disc stove, 6 inches in diameter, takes 440 watts at 10 cents per K.W. hour	.044

In addition to these heating devices of the range proper, a 3 pint blazer, a 3 pint double broiler, a 5 quart vegetable boiler and a 4 quart tea kettle completed the equipment. A meal for six persons was cooked and a record kept of the time, kilowatts, cost and manner of handling the heat. The bill of fare included a breakfast, a dinner, a supper and a less expensive dinner. As an ocular demonstration of this kind means more than theoretical conclusions regarding the same, the menu and its electrical costs are given in full.

ELECTRICAL COST OF COOKING MEALS FOR SIX PERSONS—It is supposed that in the electric stove and devices used, heat insulation methods are employed. If water is evaporated into steam at atmospheric pressure, an extra allowance of 0.285 of a kilowatt hour per pound is necessary in calculations. It is also to be understood that the efficiency of heating varies from 50 per cent. with external heaters to 95 per cent. under the best conditions of internal immersed heaters. An average efficiency for polished nickel or copper vessels, covered, using immersion heaters, is about 85 per cent. With these conditions fulfilled, experiments have shown that the costs given in the table that follows may be relied upon as representing the power consumption for four meals.

The table appearing on the opposite page is of exceptional interest to everyone interested in electric cooking. It depicts in a concise manner just what may be done with electric current and at what cost. The table also states the type of electric heating utensil to employ for cooking the various kinds of food. Cost of cooking other food requiring approximately equal time may be estimated.

MEALS FOR SIX PERSONS COOKED ON AN ELECTRIC RANGE

Food.	Quantity.	Operation.	Utensil.	Use High Heat Before Cooking.	Use High Heat.	Use Medium Heat.	Use Low Heat.	Leave with Heat Off.	Total Time of Cooking.	Kilowatt-hours.	Cost of Cooking for 6 persons at 3c. per K.W. Hr.
Breakfast.				Run Heaters as Follows							
				Min.	Min.	Min.	Min.	Min.	Min.		Cents.
Oatmeal	1 cup meal	Steaming	Double boiler	20	—	25	—	5	30	0.26	¾
Broiled ham	1½ pounds	Broiling	Broiler	5	8	—	—	3	11	0.28	¾
Sauté potatoes	6 cold	Frying	8″ pan	8	12	—	—	3	15	0.24	¾
Cream muffins	12 in pan	Baking	Oven	30	10	5	—	5	20	0.93	2¾
			Total								5
Dinner.											
Cream spinach soup	2 qts.	Boiling	6″ blazer	—	47	18	—	—	65	0.43	1¾
Roast beef	4 pounds	Roasting	Oven	—	63	17	—	—	80	2.29	6¾
Cottage pudding	1 pan	Baking	Oven with beef	30	10	10	—	5	25	0.32	1
Mashed potatoes	2 pounds	Boiling	6″ double boiler base	10	12	25	—	—	37	0.28	¾
Squash	3 pounds	Boiling	Veg. boiler	3	15	30	—	—	45	0.54	1¾
			Total								4½
Supper.											
Egg salad	6 eggs	Boiling	6″ double boiler	—	10	—	15	—	25	.22	¾
Dressing	——	Boiling	6″ double boiler	10	—	7	—	3	10	.22	¾
Raised biscuits	1 dozen	Baked	Oven	30	10	10	—	5	25	1.02	3
Layer cake	2 layers	Baked	Oven with biscuits	30	10	5	—	—	15	0.28	1
Stewed prunes	1 pound	Stewing	6″ blazer	—	30	10	—	—	40	0.24	¾
			Total								5½
A Less Expensive Dinner.											
Lamb chops	10 chops	Broiled	Broiler	—	35	20	—	—	55	0.36	1
String beans	2 quarts	Boiled	6″ double boiler	25	3	92	—	—	95	1.11	3¼
Steamed pudding	1 lb. 4 oz.	In mold	8″ vegetable boiler	—	12	—	—	—	6	0.07	¼
Lyonnaise potatoes	6 cold	Fried	8″ fry pan	6	10	—	—	3	13	0.35	1
			Total								5½

Average cost per day for each person at these rates, 2⅓ cents.

As these figures are taken from the records of one of the largest manufacturers of electric cooking devices in this country they are authentic on the basis given. The fact that an allowance of only 3 cents per kilowatt hour is given does not alter the relative costs of cooking different viands. It is evident that

practicality, cleanliness, celerity and results are all embodied in this system. Special rates for electric stoves would necessitate a special meter attached to them for this purpose. The widespread use of them in the East would mean a suitable change in their cost as well as an agreeable charge for current. Considering the labor saved, the actual cost of electric cooking is even lower than that given.

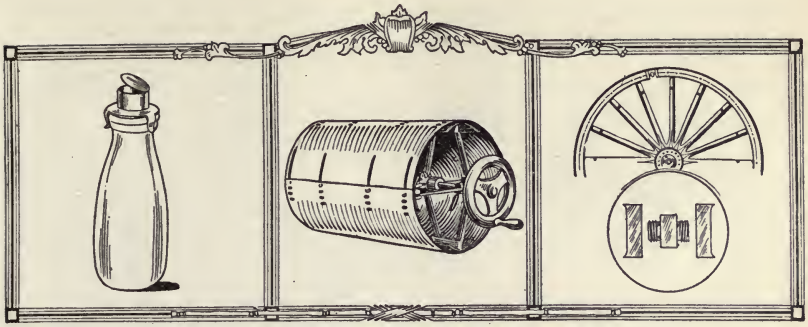
Luminous and Air-Heater Radiators—Luminous radiators simply consist of electric lamps of the incandescent type set into a metal frame of convenient shape. They are placed anywhere in the house or set into the fireplace. The wattages they consume vary from 500 to 750 to 1000. This type is employed because the light efficiency of incandescent lamps of the carbon filament type is less than 5 per cent. The rest of the electrical energy is transformed into heat. Consequently more than 95 per cent. of the power is utilized as required in this manner. Air-heater radiators on the other hand, of the general type in use in electric cars, divided up into 500-watt heating elements, two to six of which are used in each heater, range from 1000, 1500, 2000, 2500 to 3000 watts apiece. Car heating in winter costs about 2.25 cents per hour or 40.5 cents per car day of 18 hours. It has been stated that tests of Boston cars of two doors, 12 windows, and 850 cubic feet of space can be raised 25 degrees Fahr. in severe weather with an expenditure of 2.5 kilowatts. On this basis, room warming by electricity, would not represent so severe a test. According to Houston and Kennelly, in the case of the Vaudeville Theatre, in London, England, about 16 heaters are employed; four large portable ones with attachments at the center and sides, and twelve around the walls. The energy consumption is 300 watts for the smaller, and 1200 watts for the larger of the heaters, about 11.4 kilowatts in total. The temperature of the auditorium is raised 20° Fahr. by them. The price charged is 8 cents per kilowatt hour, the cost of heating 72 cents per hour, and to warm the theatre for 4 hours, it costs $2.88. From these figures, it is evident that with twice as many heaters, and a 3-cent per kilowatt hour rate, the cost would be less.

In those cases where labor is employed to operate machinery, it is necessary to subtract this cost from that of the electric power consumed, if by the introduction of that power the labor is not needed. In the case of electric heaters as that of gas heaters, labor is at a minimum. No attendance is required, there is no coal stove, no dirt or ashes. In the gas stove the air is vitiated and the danger of asphyxiation is ever present. The electric heater obviates all these risks, and, therefore, by the ordinary laws of progress is destined to supplant its predecessors. By the same inevitable logic, the electric range will create a revolution in the domestic sphere of the feminine world. It is a perfect instrument and of ideal construction. By its means, labor is reduced and comfort increased so greatly that, unless women value their labor very lightly, the electric range is by far the cheapest addition to the home.

ELECTRIC POWER PLANT IN PALESTINE

Even in Palestine, where living is almost as primitive now as a thousand years ago, electricity has been introduced. There is now one electric plant belonging to the agricultural colony Rishon-LeZion, where the famous carmel wine is made. The colony was founded some thirty years ago by penniless refugees from Russia.

The Rishon-LeZion colony is now equipped with the most modern machinery for the making of wine. Most of the machinery, as well as the illumination of the colony, depends on electric current from a power plant situated within the colony and said to be the only one in the Holy Land.



Sanitary Milk Bottle Cover. Collapsible Concrete Form. Steel Tire Tightener.

RECENT AND IMPROVED DEVICES

Sanitary Milk Bottle Cover

The serious menace of unsanitary milk containers has long been recognized, and of late years many steps have been taken to prevent the inoculation of milk with typhoid germs through the introduction of various devices to close the milk containers. The paper disc cover was one of the first destined to come into widespread use, and so far as it goes, this cover admirably fulfills its purpose. There is still danger of contamination, however, after the milk bottle has been opened in the home; a fly, for instance, may enter the neck of the bottle and leave enough typhoid bacteria to cause an epidemic in the family.

To further safeguard the users of milk, the device shown in the illustration has been put on the market. It consists of a combined bottle-opener, cover and pouring spout. The point of one of the spring prongs is sharpened in order that it may be inserted through the paper bottle cover, thus making it a simple matter to remove the latter. The metal prongs are then pressed down over the neck of the bottle which is immediately provided with a tightly fitting cover with a hinged lid.

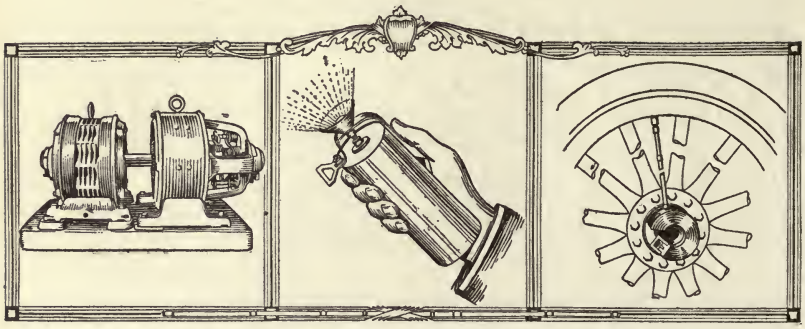
If you enjoy this magazine, tell others; if not, tell us.

Collapsible Concrete Form

A collapsible mold adapted to be used as a form in the construction of concrete culverts is now being prepared for the trade. The device is made of four pieces of sheet steel so curved that when joined at the sides an affair of cylindrical shape is formed. Running horizontally through the cylinder is a piece of pipe into which is screwed a suitable rod having a hand-wheel at the other end. To the pipe and to the rod are fastened respectively four sets and one set of arms. With a forward turning of the hand-wheel, the rod is screwed further into the pipe, which causes all of the arms to spread apart and press against the sides of the form, increasing its diameter. A reverse turning of the wheel draws the arms together and lessens the diameter of the mold. In construction work the form is embedded in a mass of soft concrete, which, when sufficiently "set," permits of the backward turning of the wheel, decreasing the diameter of the mold and making possible its easy withdrawal from the structure.

Steel Tire Tightener

To be able to fit a steel tire tightly to a wooden wagon wheel without shrinking and perhaps dishing the wheel, has long been the aim of wagon builders, but this



Generator for Picture Arcs. Dry Battery Lamp Attachment. Auto Tire Inflator.

feat has not been easy of accomplishment in the past. Now along comes an inventor with a most ingenious and practical tightener to be inserted in the wheel in place of a small section of wooden felly, which is removed with a handsaw where two sections of felly unite. The tightener consists of three pieces, as shown in the illustration; two blocks similar to square nuts, with the edges burred over to grip the felly, and a central piece having a threaded projection on either side to engage the holes in the nuts. As one projection bears a left hand and the other a right hand thread, it is obvious that by turning the central piece the nuts will be spread apart, thus serving to tighten the wheel against the inside of the tire.

Generator for Motion Picture Arcs

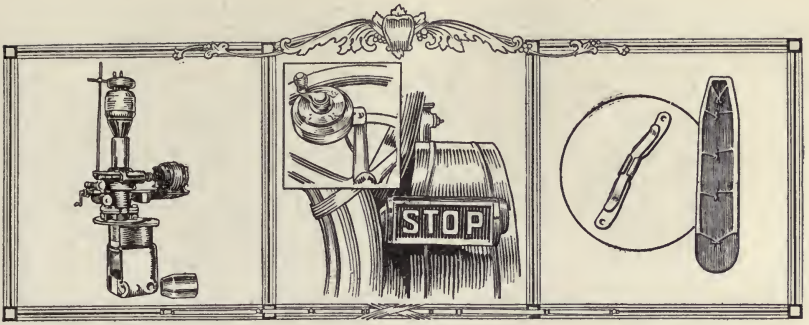
The motion picture operator who has had experience with both alternating and direct currents in connection with his projection arc lamp will be quick to express an opinion that the former type of current is an unmitigated nuisance; the alternating current arc emits a nerve-racking buzz and it seems to have a fiendish tendency to travel around to the rear of the carbons and away from the condensing lens which transmits the brilliant rays to the projector. The direct current arc, on the other hand, is perfectly quiet and a marvel of steadiness providing the carbons are fed at proper intervals. Furthermore, the direct current arc delivers at least fifty per cent. more useful light to the condenser than does the alternating current with an equal reading of the ammeter.

The increasing prevalence of alternating current illuminating systems of late years has made it difficult for motion picture theatres to obtain direct current for the arc lamps without the use of costly and sometimes unreliable generating plants. To meet the naturally large demand for a means of direct current supply, the motor-generator set shown in the illustration has been introduced.

Dry Battery Lamp Attachment

Another lamp attachment for the standard dry battery! Seemingly there is no end to them. The writer of these columns has selected one after the other, each having some advantage in point of cheapness, simplicity or general utility over the others, and still they come.

Simplicity is certainly the greatest claim of the attachment illustrated on this page. The device is a stamping of sheet metal to which is attached the reflector and miniature socket. In the end of the stamping is a hole which permits the attachment to be hung on a hook or,



Portable Cylinder Grinder. Auto Traffic Signal. Ironing Board Cover

if desired, the battery may be laid on its side when the attachment prevents rolling. The circuit is made by pressing the extension of the stamping with the thumb, thus bringing the central terminal of the lamp base into contact with the carbon terminal of the battery.

Auto Tire Inflator

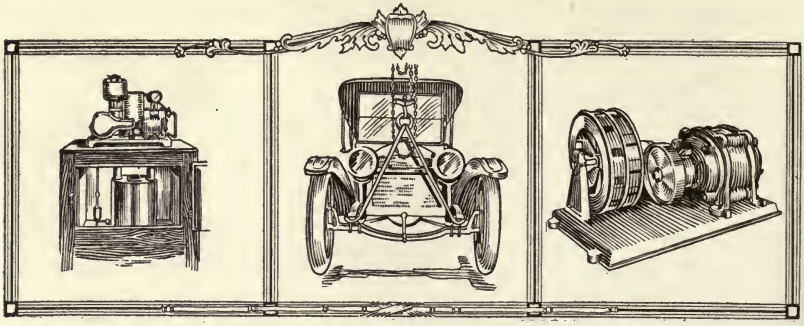
No longer is it necessary for the autoist to stop his machine along the hot and dusty road to pump up his tires—an annoying job at best even though a motor pump of some kind be used. The device illustrated herewith provides a continuous connection between the tire and a motor-driven pump attached to the chassis of the car. It is thus possible to inflate the tires even while the car is running and without having to do more than start the pump. The ingenious feature of the device is found in the rotary joint at the hub of the wheel by means of which the air is delivered to the moving wheel.

Portable Cylinder Grinder

After an internal combustion engine has been operated under full load for a long time, the bore of the cylinder tends to take an elliptical shape; the increased friction of the piston against the wall of the cylinder at every working stroke being responsible for this condition. Heretofore the remedies for this condition have all been expensive and have necessitated a considerable delay. The option has been to buy new cylinders, pistons and rings; to have some machine shop bore out the cylinders in a lathe—at best an expensive and uncertain job; to use adjustable reamers which seldom work with any degree of accuracy; and, fourth, to return the cylinders to the motor factory to be ground out on the elaborate machines used in the original manufacture. The latter method is recognized as the right one, but it entails the expense and delay of shipment to the distant factory and return.

The need for a portable grinder that could be installed in the up-to-date garage repair shop has been recognized for some time, and the want appears to have been filled by the machine illustrated on this page. This device is so designed that it may be applied to any motor cylinder regardless of its size, and, at a remarkably low operating cost, grind out the cylinder quickly and accurately. The machine is operated by two small electric motors which may be driven by current taken from a lamp socket. The grinder should prove a boon to the autoist through the agency of the garage man, who will have a new and profitable field opened up before him in the event that he installs one of the machines.

The latest model touring cars have electric lamps for illuminating the tonneau; these being set flush in the back of the front seats.



Ice Machine for the Home. Automobile Jack. Motor-Driven Alarm Siren.

Auto Traffic Signal

No longer is it necessary to hold out the hand as a crude and frequently misleading signal to the man behind when driving the car. With the rapid development of automobile accessories of all kinds it was inevitable that a device should be produced to render unnecessary this dangerously ambiguous form of signaling. The device illustrated herewith appears to fill the bill in every particular, affording, as it does, an effective means of showing the driver in the rear whether the machine is to stop or turn to the right or left.

The control is electrical and a small controller on the steering wheel of the car serves to operate the signal. The signal is plainly to be seen by either day or night. At night the signal remains dark on blank, but is automatically illuminated on "stop," "right," or "left." The operator is immediately notified of the operation of the signal by a small bell attached to the signal case, as well as the signal flashed to drivers in the rear.

Ironing Board Cover and Clamps

A simple device recently introduced on the market renders it unnecessary to sew, pin or tack the cover to the ironing board as in the yesterdays. The complete device consists of a properly cut and hemmed cover, fitted with tapes for attachment, and a set of five cleats which are attached to the under side of the ironing board. In use the cover is held to the board by drawing up the tapes and securing them to the cleats as the illustration shows. The convenience of the arrangement, to say nothing of the advantage of being able to draw the covering taut in a few seconds' time, should commend it to every housewife.

Ice Machine for the Home

The demand for modern conveniences in the home has been met with sanitary plumbing, electric lighting and heating, the vacuum cleaner, electric washer, and other time and labor-saving devices. Automatic machinery of every description has been perfected as a means of adding comfort and security to the home, all of which has done much to emancipate the housewife from the former drudgery. But with all of this progress, one of the most vitally important of all of the household appliances appears to have been somewhat neglected up to the present time—the refrigerating system. It is true that ice boxes have been vastly improved in recent years and much has been done to prevent the inevitable dampness of the ice box from exerting its deteriorating influence upon the foodstuffs in the refrigerator. Present-day knowledge, however, tells us that ice refrigeration is wrong in principle as compared

with the more up-to-date system in which a low temperature is produced by other means.

The appearance on the market of a refrigerating machine designed expressly for use in the home, and combining every desired feature of simplicity, low cost, and safety, is therefore of great interest in the field of new devices. Unlike most other machines of this nature, this outfit does not employ ammonia, sulphur-dioxide, or carbon-dioxide as its freezing agent. While the precise nature of the agent used is not disclosed by the manufacturer, still it is said to have some remarkable properties, among which may be noted a freedom from dangerous and unpleasant fumes. A further feature of safety is found in the comparatively low pressure employed in the machine—from sixteen to twenty pounds.

The machine is quite automatic in its operation, which is controlled by a thermostat, while the motive power is supplied preferably by an electric motor, unless another source of power is at hand and is more convenient under the circumstances.

Automobile Jack

When the garageman wishes to remove the wheels, springs or axles from a car, he usually has an uncertain, and, to say the least, annoying task before him. The conventional form of jack placed beneath the edge of the car body at four points will do the trick, but these jacks at times have a most provoking tendency to slip sidewise, frequently resulting in a loss of time and temper, to say nothing of possible damage to the car if it is let fall to the floor when, perhaps, two or more wheels have been removed. The device shown in the illustration is designed to do the work of the jacks quickly and with a maximum of safety. It consists merely of a pair of iron rods with hooks in their ends and joined to the end of a chain which is part of a block and fall, with automatic check, attached to the ceiling of the garage. One of the contrivances at the back and one at the front of the car will enable the workman to lift the car bodily from the floor.

Motor-Driven Alarm Siren

The value of the siren as a fire alarm signal has long been recognized, but the failure of a number of these devices at the crucial moment, due to a lack of sufficient air pressure at the time, has resulted in their having acquired a reputation for unreliability. To prevent the possibility of such failures and still to retain the desirable alarm-sounding qualities of this form of whistle, a motor-driven siren has been placed upon the market. It is so arranged that by opening and closing the motor switch at short intervals the pitch of the emitted note can be quickly changed and the true siren effect produced. The device is admirably adapted to use in plants where steam has previously been the motive power, but where electricity has superseded the steam.

The alarm should prove excellent for small towns having volunteer fire departments where it is necessary to give a general alarm whenever a fire breaks out. By placing the siren on top of a building not far from the local telephone exchange, the control switch for the alarm may be placed within reach of the telephone operator, who can immediately start the siren in operation when an alarm is given by telephone. Other switches at convenient points in the town would expedite the sounding of the alarm. This ease of remote control is an important feature of the device.

Motion Pictures Are Used to Record Plant's Growth.

An apparatus invented by Professor W. C. Stevens and L. M. Peace, of Kansas University, is being used to take motion pictures of growing plants. The rate at which the pictures are taken is varied with the growth of the plant, some plants growing more rapidly than others, and many plants growing faster at certain stages of their development than at other periods of their life. Moving pictures are thus being used in still another educational field — incidentally proving a source of amusement as well as instruction.

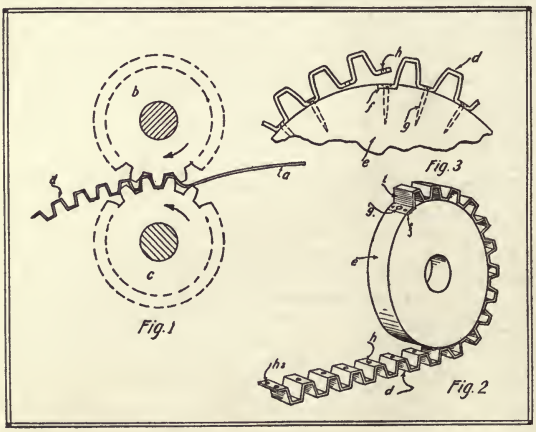
Gears for Models and Toys

As a solution to the problem of making gears for wooden models of inventions, toys or light experimental work, the following description of the accompanying sketches is a very simple and efficient way out of the difficulty. And this construction will be found superior to the plain, circular wooden discs—which many inventors use and in which they depend upon friction—as it insures a positive movement and will transmit considerable power.

Cut tin or other thin metal into strips *a* equal to the width of the gear desired and run it between any gears *b* and *c* with small teeth, found on some convenient machine, thus forming the teeth as shown at *d*. Then turn up the wooden disc *e* to a diameter equal to the tooth-bottom diameter of the gear to be made, less twice the thickness of the metal used. Make the holes *h* with a small brad before attaching the teeth to the disc. Next make the recess *f* in the disc equal in depth to one thickness of the metal; this is necessary because when attaching the final end the lap would otherwise interfere with tooth clearance. The side *i* of the first tooth should be lengthened slightly before attaching to allow for the recess *f*. Use small flat head brads *g* between each tooth.

Contributed by

R. N. VanBuskirk.

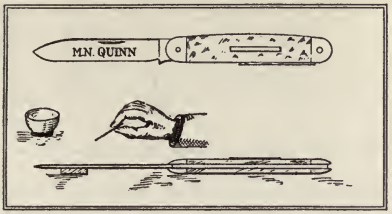


Etching a Knife Blade

The blade of a knife or other tool may be marked with the owner's name by means of a simple etching process which may be carried out in the following manner: Prepare the blade by cleaning thoroughly, making sure that it is free from grease, and then cover both sides thoroughly with asphaltum paint or varnish. After this has dried for eight or ten hours, take a metallic instrument having a sharp point and scratch the name or other marking through the asphaltum and down to the blade just as you wish it to appear when finished. Apply a second coat of asphaltum around the edges of the lettering, but be careful not to let it cover any of the scratched places. Allow the second coat to dry thoroughly and you are ready for the etching.

To prepare the fluid, mix one part of nitric acid with two parts of

water in a small glass or cup, taking care to add the acid to the water and not the reverse. Lay the knife down with the



blade supported in as nearly a level position as possible with the lettered side up. With a straw or toothpick, transfer to the blade a few drops of the acid—just enough to cover the scratched portions of the blade. As the acid bubbles away, add a few drops more. Examine the etching occasionally, and when sufficient depth has been gained, rinse off the acid and remove the asphaltum with a rag wet with turpentine. The blade should then be thoroughly washed with soap and hot water. The letters will show very distinctly, and once placed, they cannot be removed except by very deep grinding.

Contributed by

MANLY N. QUINN.

Refinishing Old Floors

A soft wood floor, such as Georgia pine, which has become rough and blackened from hard use and little care, can be refinished and made as good as new. The work does not require professional skill, but can be done by any able-bodied man at a slight expense and with a moderate amount of labor.

The first operation is to plane off the rough, blackened surface till the clear grained wood beneath appears. The final finishing cut should leave the surface clean, bright, smooth and level, which is accomplished by setting the blade to take a thin shaving. The baseboard moulding should be removed to secure the best results. The corners and strips along the walls which cannot be reached with the plane can be cleaned off with a cape chisel and with a scraping tool made by grinding a plane blade at a rather blunt angle. A small hand emery wheel which can be clamped to the window sill is essential, as every tool must be kept very sharp to do good work and to reduce the amount of labor.

The second operation is to sandpaper the floor until there are no plane marks left, using a coarse grade first and fine at the last.

The third operation consists in spreading on a coat of white shellac evenly, using a full stock brush about three inches wide. It is important to select a full stock brush with the bristles set in tight, so that none will pull out while in use. When the shellac is dry, polish with fine sand paper and then apply another coat. Use wood alcohol for thinning if required. When the last coat of shellac is dry apply a coat of floor wax with a soft white rag, which leaves the floor ready for use.

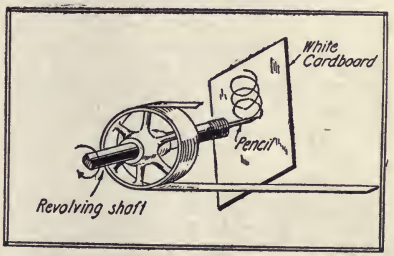
Finished in the manner described, the floor compares favorably with hardwood and in appearance it is infinitely better than the mere painting which is so common for pine floors.

Contributed by

BENJ. B. JACKSON.

Makeshift Speed Indicator

A simple method of determining the number of revolutions per minute of a shaft is to tie a pencil to the surface of



the shaft and when the latter is revolving, to pass a piece of stiff cardboard at right angles to the pencil for a fraction

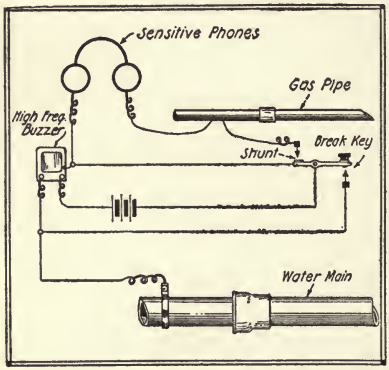
of a minute, letting the point of the pencil describe a series of circles on the cardboard. By timing the period for which the card is held to the pencil and then by counting the number of convolutions appearing on the card, the user will be able to tell immediately the number of revolutions per minute of the revolving shaft

Contributed by

JAMES MCINTYRE.

Pipe Line Telegraphy

It is sometimes possible to employ the gas and water pipes in lieu of a regular wire telegraph line in cases where the latter is impracticable. The circuit shown



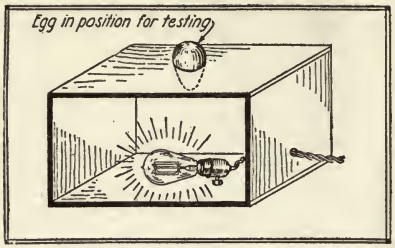
in the accompanying illustration will usually work over a distance of a block or two. The diagram shows a "break in" system in use, but this is, of course, not essential to the operation of the sets. The usual circuit can be employed as well, the gas pipe being used as the overhead wire and the water pipe as the ground.

Contributed by

IRVING FARWELL.

Electric Egg Tester

The simple device shown in the accompanying illustration will enable one to determine instantly whether or not an egg is fresh, or, indeed, its actual degree of decay in the event that it is



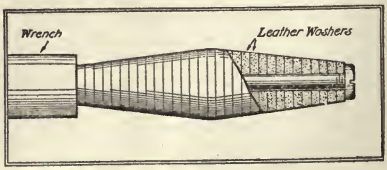
not strictly fresh. The tester comprises a small wooden box in which is mounted an incandescent lamp. In the cover of the box is a hole of a size that will permit the egg to rest in it without passing through. The tester is used either in a darkened room or with a cloth thrown over the user's head to exclude extraneous light. A strictly fresh egg will appear as a clear pink glow, while a partly decayed egg will show a dark blotch in it. After a little experience has been gained by comparisons, the user will be able to tell to a nicety just the condition of any egg placed in the tester.

Contributed by

STANLEY RADCLIFFE.

Everlasting Wrench Handle

A wrench handle of great durability and one that at the same time affords a splendid grip, can be made by slipping a series of leather washers of gradually increasing and decreasing diameter over the steel stud which passes through the wrench handle. The washers may be cut roughly to size from a strip of leather belting, punched with the correct size of hole and assembled on the stud before being cut to the finished size. A coarse rasp and a sharp knife will enable the worker quickly to shape up the handle as desired. If the washers are assembled



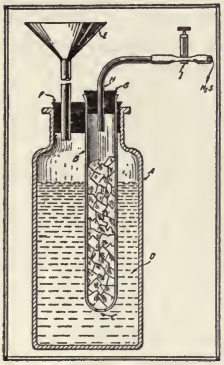
with glue before being drawn up with the nut at the end of the stud, the handle will be far more substantial.

Contributed by

HARRY J. MURPHY.

A Simple Hydrogen Sulphide Generator

In the accompanying illustration is shown a suggestion for a simple H_2S generator of great practical value in the laboratory. The generator may be described as follows: *A* is a bottle of about ½ liter capacity, *B* a six-inch test tube with a hole *C* punctured in the bottom by means of a blow pipe, *D* is the acid solution, *E* is a thistle or funnel to permit of influx or efflux of air, *F* and *G* are rubber stoppers suitably bored to receive their respective inserts, and *H* is a bent delivery tube, while *I* is a pinch-cock.



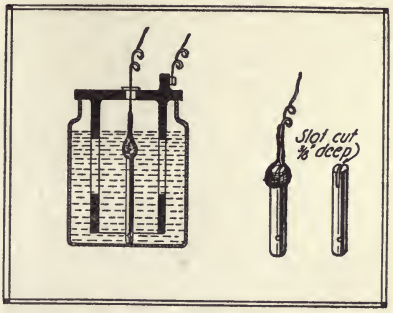
When the pinch-cock is opened the weight of the acid solution pushes part of it up and into the test tube. The acid then reacts with the iron sulphide in the tube and H_2S is evolved. If, then, the pinch-cock be closed, a pressure due to the gas is formed which pushes the acid solution out of the tube. The excess of the gas bubbles up through the acid and out through *E*.

Contributed by

FRANCIS B. COYLE.

A Method of Economizing on Battery Zincs

The contributor was recently confronted with the problem of securing continued service from a carbon cylinder battery after the zinc has been practically exhausted and at a time when it was not possible to procure new zincs without some delay. The desired result



was obtained by cutting off the eaten portion of the old zinc, securing a length of insulated copper wire to the zinc, coating the union with a liberal amount of wax to prevent local action between zinc and copper wire, and finally immersing the zinc by suspending it from the wire. This plan permits of the use of the very last inch of zinc and it proved to be a very practical solution of the difficulty.

Contributed by

EDWARD M. DAVIS.

Self-Starting Nuts

A nut may be made to catch its thread quickly and easily by counterboring the under side with a hole as large as the clearance size of the screw. When such a nut is placed on the screw, the counterbored portion holds it in the proper position to catch the thread without difficulty.

If a nut, such as a knurl on a binding post, is to be removed from its screw frequently, the counterboring should be continued until there are but two full threads left. The nut may then be instantly removed and replaced.

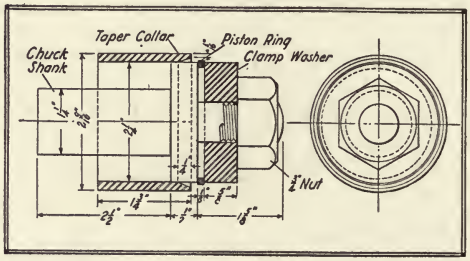
Contributed by

CLARENCE H. ANDERSON.

AIR VALVE PISTON RING CENTERING DEVICE

By W. G. Astle

Piston rings for the air valves of locomotive air compressors are made slightly eccentric and cut on the thin side to give the requisite spring to cause them to form a good, tight joint. The piston rings are made from a long ring, from which a large number may be cut. The outside of the stock sleeve is turned to a diameter larger than that finally required, and then the sleeve is offset the required amount, the inside being bored to a correspondingly larger diameter than that of the final inside diameter of the piston ring. The stock sleeve is then cut to form rings of the necessary thickness. These rings are slotted at an angle of 45 degress to form the spring allowance, and sprung together at that point. In springing the rings together, the varying radial thickness of the rings causes them, when compressed, to assume a final shape that is not a true circle, so that it is essential to take a light, final cut over the outer face in order that they will form a true fit inside the cylinder.



The object of the device shown herewith is to chuck the work so that this final truing-up may be quickly accomplished. The device consists of a main body, with a shank at one end for chucking in the lathe, and a threaded shank at the other end, over which a washer for clamping is slipped and secured in position by a ¾ inch nut. Over the main body of the device there is a closely fitting collar, the inner bore of which at the clamp washer end is tapered.

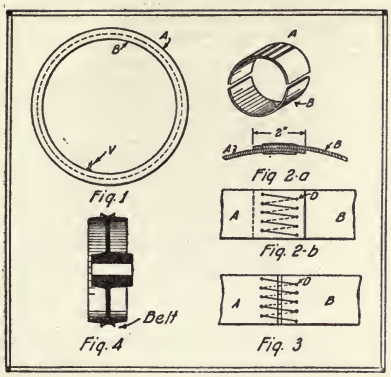
The operation is simple. The ring to be finished is placed between the main body and the clamp washer, which is loosely fitted up to the ring. Over the body the taper collar is slipped and forced over the piston ring, compressing the latter and at the same time centering it with regard to its outside diameter. When compressed to the limit the clamping nut is tightened, and the taper collar slipped off from the main body which is then chucked in the lathe by the chuck shank, and the outside of the ring trimmed down to a true circle. This tool was devised by a machinist in the shops of the Timiskaming and Northern Ontario Railway. Particularly rapid work can be accomplished with the device, and it will produce a ring that has not the same tendency to leak as an ordinary ring that has not been re-turned will have.

It is quite possible that this tool can be applied to other purposes.

Belt from Bicycle Tire

The tread of a bicycle tire, *A*, Fig. 1, makes an excellent belt for use on crowned pulleys. The tire is to be cut through the center as shown in Fig. 2a and if the length is correct, the belt needs no splicing. Should a splice be necessary in order to fit the belt to a certain machine and its driver, the joint may be made either as shown in Fig. 2b or as shown in Fig. 3. The latter is preferable if well done. Fig. 4 shows how the belt rests on the pulley.

The inside of the tire, *B*, of course, cannot be used in one continuous piece owing to the presence of the valve and



the weakness of the tire at that place if the valve stem is removed.

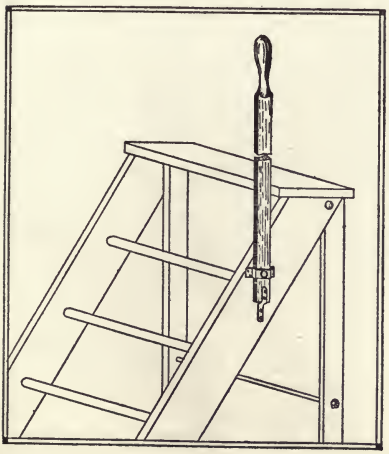
The belt should always be removed from the pulleys if the machine is to stand idle for any length of time in order that stretching may be avoided.

Contributed by

F. M. D.

Handle for Stepladder

When standing on the top step of a stepladder it is at times difficult to maintain one's equilibrium and the device shown in the illustration is intended as an aid to those who have frequently to make use of a ladder in this fashion. The device is merely a removable handle projecting upward for a few feet in order that the user may have a balancing grip upon which to hold when standing on the top step.

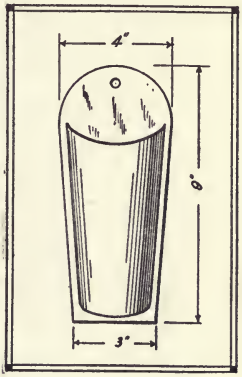


Contributed by

JACOB LIEBMAN.

Cotton Waste Holder

In a manufacturing plant of the middle west, the question of handling and preserving cotton waste has received much consideration. The waste reaches quite an amount in the average large shop, particularly if a good grade is used. For this reason as well as from the standpoint of a fire risk, the provision of a suitable receptacle at every machine and work-bench is quite justified.



The holder shown in the illustration is readily made in small quantities and, in the above-mentioned plant, its design has proven of great value. The holder consists of three pieces of tin cut to the shape and size indicated and soldered together.

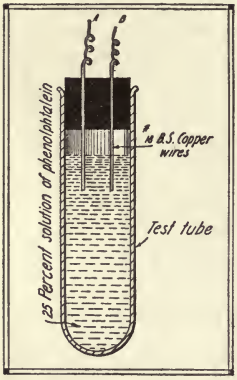
Contributed by

P. W. BLAIR.

Polarity Indicator

In the illustration is shown a simple polarity indicator which may be made by any electrical workman at a cost of a few cents. A ⅝-inch test tube is filled with a 25 per cent. solution of "phenolphtalein"

which may be obtained from any chemical house. The cork of the tube is fitted with two pieces of No. 18 copper wire and sealed in place with sealing wax; the ends of the wires projecting down into the liquid for a fraction of an inch. To use the instrument, the poles of the circuit are connected with the wires leading to the indicator and immediately a red coloration forms around that terminal, which is the positive. On removing the current and shaking the tube, the coloration disappears and the indicator is ready to be used again.

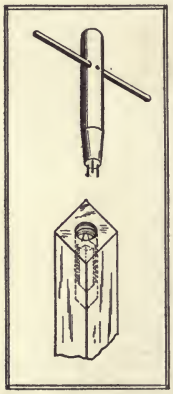


Contributed by

SAMUEL COHEN.

To Remove Broken Tap

The contributor has found the device shown in the illustration to be of great value when a tap has been broken off inside a valuable piece of work. The device consists essentially of a short length of cold rolled steel rod into the end of which are inserted three short pieces of steel needle or stiff steel wire. A handle facilitates turning the implement. Obviously the pieces of needle are so disposed that they will fit in the grooves of the broken tap in order that the latter may be removed by applying the instrument and turning backward very carefully. Should the tap be broken off in slate or some soft metal the support for the three pins may be of hard wood, in which case it is a simple matter to make the device at a moment's notice.

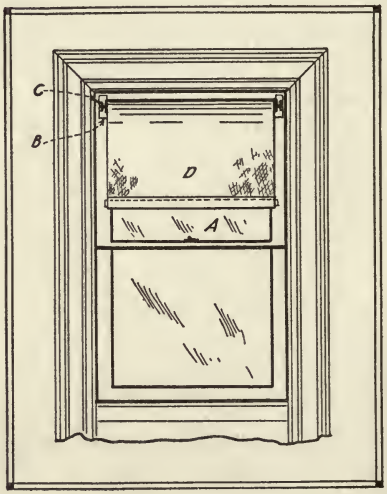


Contributed by

V. BAZIRJIAN.

A New Method of Hanging a Shade

In the illustration may be seen a novel suggestion for hanging a window shade.



Blocks of wood, *B*, 2½ inches long, one inch wide and 1½ inches thick are secured to the top of the frame of the upper sash on either side. On these blocks, the shade brackets are secured. The shade should be of a width that will fully cover the window glass, yet fit inside of the window casings.

The top window may be pulled down and the shade will come with it, permitting a free passage for the air and at the same time preventing the unpleasant flapping that is so disastrous to a shade.

Contributed by

T. D. TRICKEY.

MAKING A WOODEN CHECKER BOARD

By Alfred R. Wagstaff

The following article describes the making of a checker board which, when completed, contains 82 pieces of wood and is a beautiful piece of furniture.

The best effect may be procured by using bird's-eye maple for the light squares, and mahogany for the dark squares and outside strips, although the board can be made of light and dark gumwood and trimmed with black walnut.

The first step in the making of this checker board is to make the squares, eight strips of wood being required, four dark and four light. These should be planed and squared so as to measure ⅞ inch thick and 1½ inches wide and about 12¼ inches long. Glue them together as shown in Fig. 3, making sure to get them level.

While these are drying, the bottom can be made so that no time may be lost. Secure six pieces of ½-inch pine about 18¼ inches long and cut these 3 inches wide. Glue and clamp them securely so that they will not buckle. Now return to the checker squares and mark them off as shown by the dotted lines in Fig. 2. Saw along these lines and plane the edges so as to fit together. Then glue them together as shown in Fig. 3, turning alternate strips end for end.

When this is dry, smooth off one side and mark it X. Take the bottom and smooth off one side and fit the side of the checker square marked X. Glue this square exactly in the middle and clamp securely.

The next step is to make the veneer strips. These are cut ⅛ inch thick, 3 inches wide and about 18 inches long.

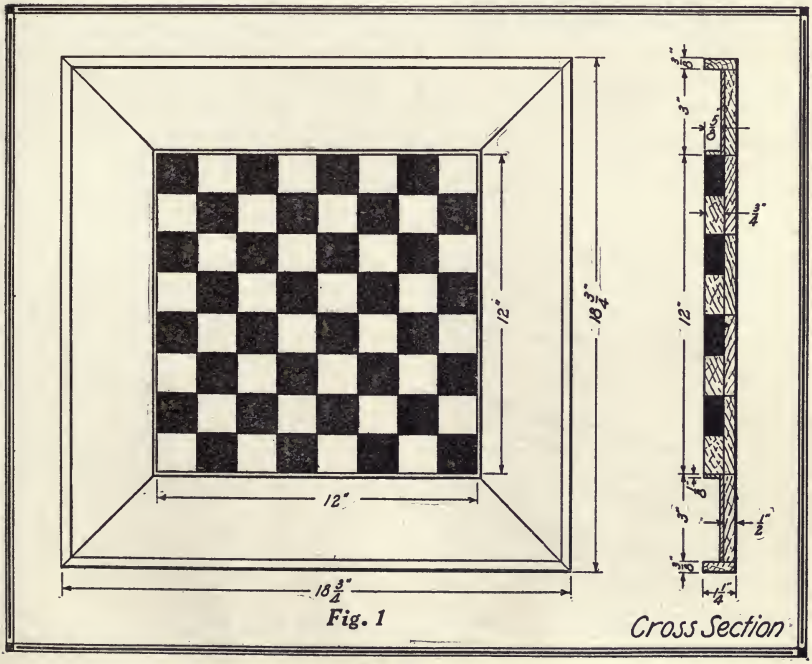


Fig. 1

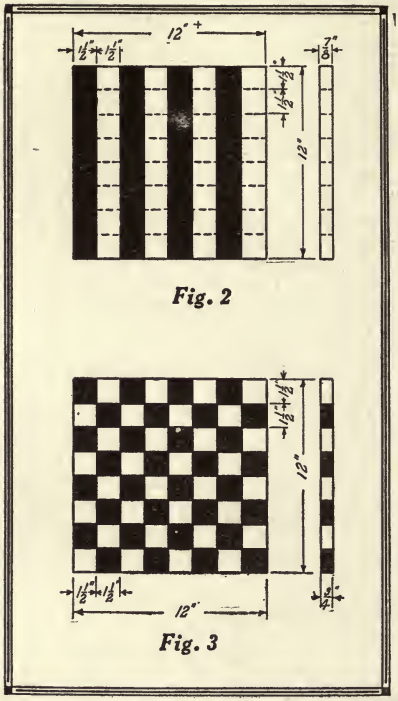


Fig. 2

Fig. 3

Fit them on the base and glue, thus forming the bottom of the tray. Now plane off the top of the squares, making them about ¾ inch thick.

Four strips of mahogany or black walnut are cut ⅛ inch thick, ⅝ inch wide and about 12¼ inches long. These are fitted and glued around the checker square as shown in Fig. 1. Cut four more strips of the same kind of wood ⅜ inch thick, 1¼ inches wide and 18¾ inches long. These are finished and nailed around the outside of the board, thus forming a trough. Give the board a good sandpapering with coarse sandpaper first, and then fine.

If the board is made of gumwood, a coat of clear filler is needed to bring out the distinction between the dark and light squares and give it a better finish. Any desired finish may be used, but a ground coat of shellac, well sandpapered and given a coat of clear varnish, makes a very fine board.

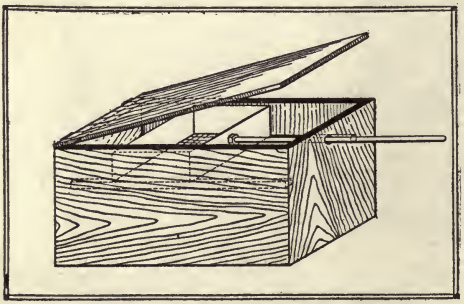
Celluloid Containers

The contributor has found celluloid to be a very useful substance in the construction of small battery jars. The sheet stock may be softened by immersing in hot water and bent to any shape desired. A solution of scraped celluloid in alcohol will form a good cement with which to join the seams.

Contributed by JAMES RITCHIE.

TO SIFT ASHES WITHOUT DUST

During the winter it is often disagreeable to go outside in the cold to sift ashes, and to do the work in the basement ordinarily results in a cloud of dust that seems to go through the house. A few minutes' work, however, will suffice to make a device that will not only lighten the labor of handling the sieve, but will at the same time prevent the obnoxious dust from floating through the atmosphere.



To make the device, take a deep box—one that will hold a week's accumulation of ashes, if possible. The box should be about as wide as the sieve. Take two boards about an inch square in section and fasten on the inside of the box to provide a track on which the sieve may slide. In one end of the box cut a hole through

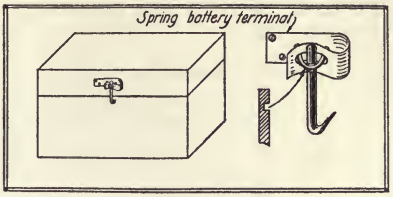
which the handle of the sieve may be inserted. Hinge a cover on the box and the device is completed.

Contributed by

E. TRABOLD.

Handy Lock

The illustration offers a suggestion for a simple but effective hasp, or fastening for a small box. The fastening is made from a headless nail having a notch near its end and a binding post of the spring clip type. The latter is secured to the



cover of the box, while the nail is driven into the side. The clip engages with the notch in the nail.

Contributed by

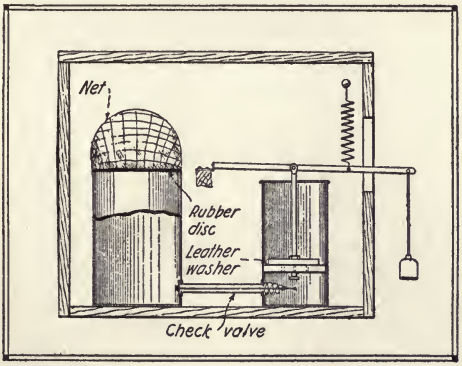
J. LIEBMAN.

A BLOWPIPE BELLOWS

By Fred. A. Berger

A serviceable, easily constructed and, withal, cheap bellows for a blowpipe is shown in the illustration. The essential features are two tin cans, one serving as the container for the air, while the other forms the pump cylinder.

The construction of the latter will first be considered. The can is of the ordinary type in which vegetables are packed. The top is removed by melting the solder, after which the inside is cleaned of any projecting bits of solder along the seam. A ½ inch hole is then drilled in the wall near the bottom for the outlet valve.



The piston is composed of two wooden discs and a leather washer. The smaller disc is permanently fastened to the piston rod which may be a long bolt. The larger disc is drilled with several holes for the air inlet, after which it is placed on the piston rod with a sliding fit. Between the two discs is placed the leather washer which should be of about the same diameter as the smaller disc. The larger disc is wound with oiled string to form a packing around its periphery and the piston is complete. The reader will see that this piston incorporates a check valve; when the piston makes its down stroke, the two wooden discs are pressed together and the leather washer seals the holes in the larger disc, while on the up stroke the discs are separated and the air passes through the openings.

The outlet valve is merely a washer fastened to the end of a long rod that passes through a tube leading from the pump to the container. A coiled spring holds the valve in a closed position on the upstroke of the pump.

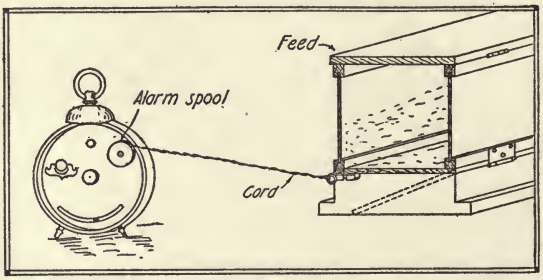
The framework and the method of actuating the piston are clearly shown in the illustration. The stirrup enables the operator to pump by foot power, leaving

his hands free to handle the blowpipe. The container for the air is a large tin can with its tin top removed and a piece of thin elastic rubber substituted. A net placed over the top will prevent the rubber from breaking should the pressure become to great. The connection for the supply piping is not shown in the sketch, but it may be made by boring a hole in the air container and soldering in place a piece of brass or copper tubing. To the latter is attached the rubber tubing.

An Automatic Horse Feeder

Anyone who has had to get up at an unearthly hour and give Dobbin his breakfast will appreciate the following suggestion.

The first step is to fasten a small spool to the alarm wind of an alarm clock. This may be accomplished in several ways, but preferably by sawing a slot in



one end and pressing it into place. The clock should now be securely braced on a conveniently arranged shelf, either with wire or by means of a small leather strap. Next, procure an empty cracker box or other suitable box and mount it upside down so that the lid swings freely on a pair of small hinges. Normally the lid is kept in place by a pin or trigger connected to the spool on the clock by a stout cord in such a manner that the spool will wind up the cord and release the grain. If convenient it would be to advantage to place the entire apparatus on the outside wall of the stall and cut a hole through just above the feed box in the manger, allowing the grain to drop out of the box into a spout conveying it to the horse. As the feed is released the alarm also sounds, and it does not take the animal long to learn its meaning.

Contributed by

AUGUSTUS SAULTIS.

A Handy Cabinet

The accompanying illustration shows a convenient way of keeping small supplies, such as rivets, brads, screws and tacks in proper order. The cabinet can be made at a small expense and it will be found to amply repay for itself in a short time by its convenience and time-saving qualities.

When the cabinet is made according to directions, the boxes can be tilted at an angle of 45 degrees without overbalancing. This feature makes it easy to see into the boxes and get out the desired articles. The boxes can also be tilted over entirely when one wishes to clean them or empty their contents into another box. With a cabinet of this kind there is no opportunity of mixing articles by having one box spill into another.

The cabinet is made preferably of cypress and measures four feet high, two feet wide (inside measurement), and six to eight inches deep. The receptacles can be made of common tin cans, the size of which may vary, although efforts should be made to secure cans of about 2¾ inches in diameter. The cans are cut afterward to two inches in height.

When the cans have been cut to the desired size, they are mounted on a base as shown in the sketch. The base can be made of No. 26 gauge galvanized iron cut to the size shown and bent at right angles at the places indicated by the dotted lines. When the base is finished it should be four inches long, a little less than three inches wide and provided with a flange on each side one-half inch wide. The hole for riveting

should be one inch from one end.

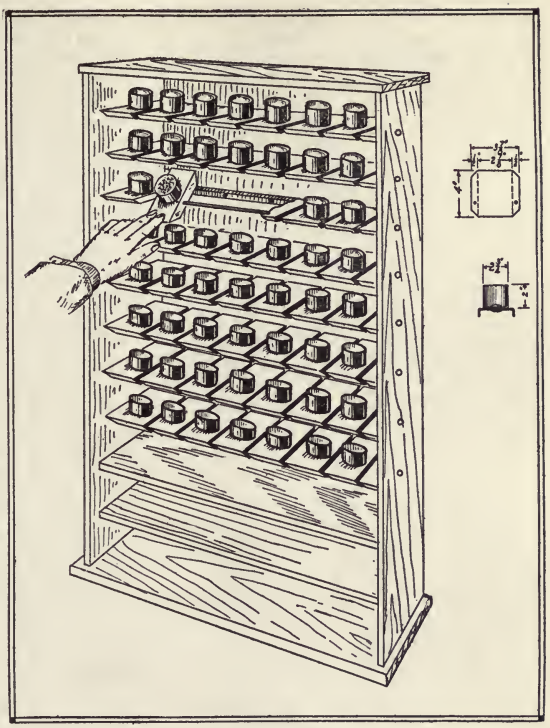
The cans are fastened to the center of the base either by riveting or soldering. Eight of these cans may be mounted in a row on a one-quarter inch rod that has been threaded at both ends so that it can be held in place by nuts. A small washer should be placed between each base on the rod in order to keep the cans from interfering with each other.

The boxes are held in their normal position by gravity, a cleat being nailed to the back of the cabinet for one end of the base to rest on. In placing the rods care should be taken to see that at least two inches is allowed between each so that the adjacent rows do not interfere with each other.

The cabinet made by the writer contained 48 boxes, while at the bottom there were placed two shelves for keeping a surplus supply of the articles.

Contributed by

J. C. LUNDHOLM.



To Cut Aluminum

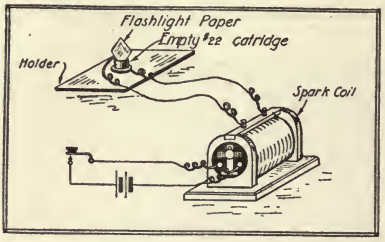
Special parts of sheet aluminum may easily be cut to any desired shape by means of what is known as a pattern maker's saw which is similar to a hand fret saw only larger and with very coarse teeth. The addition of kerosene oil in liberal quantities will greatly assist in the operation. This suggestion will be found of value to the experimenter who has tried to worry out the disc of a rotary spark gap from a piece of aluminum which, despite its softness, is at times a most difficult metal to work.

Contributed by

JAMES RITCHIE.

Electric Flashlight Ignition

When one desires to form one of a group to be photographed by flashlight and there is perhaps no assistant to ignite the flash, the suggestion offered herewith will afford a solution of the difficulty. The plan is to arrange the flash sheet and camera in the usual way and to ignite the flash by means of an electric spark produced on the pressure of the key. The necessary electrical equipment consists merely of a small spark coil, a key or button, a suitable battery and a few feet of wire. The circuit is arranged as shown in the illustration, the terminals of the coil secondary being connected with the igniter. The latter consists of an empty .22 caliber cartridge. One wire is fastened to the base of the cartridge, while the other is held with its tip projecting just inside the shell, but without touching



the latter. The flash sheet is placed with one corner resting in the cartridge and a few grains of gunpowder are placed in the latter. A pressure of the key, closing the circuit, ignites the powder, and the flame sets fire to the flash sheet. The camera shutter is, of course, open when the key is pressed.

Contributed by

FRANK A. HATFIELD.

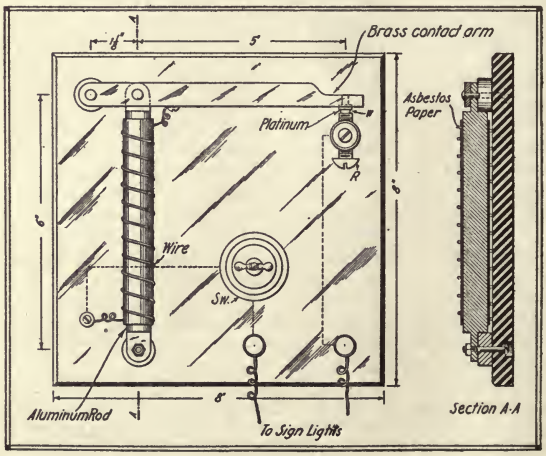
Simple Electric Sign Flasher

The accompanying sketch shows a simple and inexpensive electric sign-flashing device which the writer made several years ago for a small electric sign and which gave entire satisfaction. Its construction is obvious from the drawing. The operation of the electric sign is as follows: When the sign lights are turned on, the current passes through the German silver resistance wire, heats the aluminum rod which expands and raises the brass contact arm, breaking the circuit at *W* and darkening the sign. This cuts off the current through the resistance wire, allows the alluminum rod to cool and contract, thus pulling down the contact arm and closing the circuit at *W*, thereby illuminating the sign.

The length of time the sign is dark or is illuminated is regulated by screw *R*.

Contributed by

F. B. HAYS.



SWEDISH STEEL ELECTRIC HORN DIAPHRAGMS

It is often necessary in the course of experimental or repair work on electric horns to procure a diaphragm of special size or thickness in order to complete the horn. The price charged for new standard diaphragms is usually rather high and as a rule they will only fit one make and style of horn. In experimental work where the body of the horn is usually constructed out of material at hand, it rarely happens that any suitable diaphragm can be purchased ready made which will answer the requirements. It is therefore the purpose of this article to give a few hints on the construction of horn diaphragms in general.

The very best material from which to make the diaphragm is blue Swedish sheet steel. This steel is very tough and springy and is used by practically all of the high class horn makers. The only objection to its use by the amateur is that it is so much harder than all ordinary tools that it is very difficult to work. However, the author had no trouble in making good diaphragms by the method described herewith. In purchasing this steel, which can be bought only at a few up-to-date steel houses, the

first thing to consider is the gauge. Sheets one-fiftieth of an inch in thickness are heavy enough to make a good, substantial five-inch diaphragm. The correct thickness to use varies somewhat on different classes of horns; for instance, a mechanical horn requires a somewhat heavier diaphragm than an electrical horn. It is therefore advisable to buy two or three different gauges of steel to experiment with. Although the cost of this steel is about eighty cents a pound, five-inch diaphragms can be made at a cost of about three for ten cents.

When the proper material is at hand, it is next necessary to cut it into circular disks which can best be done with a good pair of curved tin snips. Great care should be taken not to bend the diaphragm as it is almost impossible to straighten it after cutting, but with a good pair of snips there is no need of bending it in the first place.

When the diaphragm is completely cut it is often necessary to make one or more holes in it, but as the steel is so hard it cannot be drilled even with a special high speed drill, so the best way to make the required holes is to punch them. This can be done by riveting together two flat pieces of strap steel or iron, measuring about an inch wide by one-eighth thick by several inches long, in such a manner that the diaphragm can be inserted between their flat surfaces. The next step is to drill a hole of the desired size through both pieces somewhere near their center. The diaphragm is then inserted between the two pieces and shifted about until a mark showing the location of the hole to be appears in the center of the hole drilled in the pieces of strap iron. A hard steel pin about one-thousandth of an inch less in diameter than the hole is used to cut the hole in the diaphragm; this being accomplished by placing the pin in the guiding hole in the strap iron, and giving it a quick sharp blow with a hammer. By the use of the above method and a little care, a very good diaphragm can be constructed by anyone at a fraction of the cost of a new one.

The pitch of the note produced by the horn is dependent upon the relative thickness of the diaphragm as compared with its diameter. The thicker the metal, the higher the pitch; or, with a given thickness of metal, the smaller the diameter of the diaphragm, the higher the pitch produced. With the stiffer diaphragms, however, the horn is rather more likely to become inoperative through sticking of the diaphragm and this should be taken into consideration when the tendency toward a high tone is observed.

A BOILER ROOM LOAD INDICATOR

By F. G. Matthews

The central station company that operates in Philadelphia has installed in the boiler rooms of certain of its plants indicators whereby the boiler attendants are advised graphically of the kilowatt load on the station at different periods of the day so that they can handle their fires accordingly. The arrangement comprises merely three voltmeters: one in each boiler-room and one at the switchboard operator's desk, all of which are so interconnected with a source of current and a resistance that the switchboard operator can vary the indications of the voltmeters simultaneously and at will. All of the voltmeters have scales which have been altered to read kilowatt load rather than volts. When the operator desires to telegraph the fact that a change in load has occurred he adjusts the resistance until the pilot instrument in front of him reads the number of kilowatts load then on the station. At this moment the other two instruments in the boiler rooms will indicate the same reading because of their being interconnected with and having the same calibration as the pilot instrument.

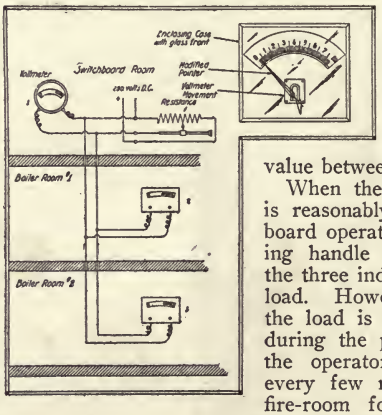
One of the boiler room indicators is shown in sketch. The circuit showing how the indicators are connected and operated is also shown.

It is of material assistance in the economical handling of a boiler plant if the stokers or firemen know the load that the plant is carrying. For example, if the

stokers see by the indicator that the load is rapidly increasing—as it sometimes does when a period of darkness due to a storm ensues, or when it becomes suddenly dark in the evening—it is obvious that more boilers must be put into service, or that those which are in service must be pushed to their maximum capacities.

Again, if the fire-room foreman sees from the position of the indicator needle that the load on the plant is decreasing, he immediately knows that he must cease heavy firing and that possibly some of the boilers should be cut out of service.

The arrangement as used by the Philadelphia company is not automatic, but is operated by the switchboard operator. In other words, the system of wiring the electrical instruments is merely an arrangement for transmitting a graphic message from the switchboard operator's gallery to the boiler room. The indicators used in the boiler room were made from Weston, D. C., station voltmeters, altered into the form shown in the sketch. The length of the pointer was increased from the usual 3 inches to 16 inches, so that the arrow end of the pointer would swing over a long scale that would be visible from any portion of the boiler room. This extension to the pointer was constructed somewhat in the form of a truss so that it would have maximum strength with minimum weight. The only portion of the original Weston meter that was retained was the movement, magnet and back board.



The scale of each indicator was divided into eight main divisions, and each one of these main divisions was divided into tenths. Assuming that each main division represents 10,000 kilowatts, the full scale deflection of the instrument would represent a load of 80,000 kilowatts on the station. Each subdivision represents a load of 1,000 kilowatts. The glass-front case enclosing each boiler room indicator was made 2 ft. 9 in. wide and 2 ft. 6 in. high.

The switchboard operator has in front of him a standard round-type direct-current voltmeter, which is indicated in the circuit, that has its scale divided from 0 to 80, and has subdivisions, each one of which represents 1,000 kilowatts.

The resistance, whereby the current through, or the voltage impressed on, the voltmeters is changed, consists of enameled wire wound on a spool.

A movable contactor is arranged to slide over the convolutions of this wire along a groove where the enamel has been removed. Thereby the contactor makes contact with the resistance wire. Electricity for the operation of the arrangement is furnished by a 250-volt storage battery used in connection with the exciter system.

It is obvious from studying the sketch that the switchboard operator can, by moving the adjusting handle *A* backwards or forwards, so regulate the voltage impressed on the three meters 1, 2 and 3, that the three meters can be made to indicate simultaneously any value between 0 and 80,000.

When the load on the station is reasonably steady the switchboard operator moves the adjusting handle occasionally so that the three indicators will show the load. However, at times when the load is changing rapidly, or during the period of peak load, the operator shifts the handle every few minutes, so that the fire-room force will always be conversant with the kilowatt load that the station is pulling.

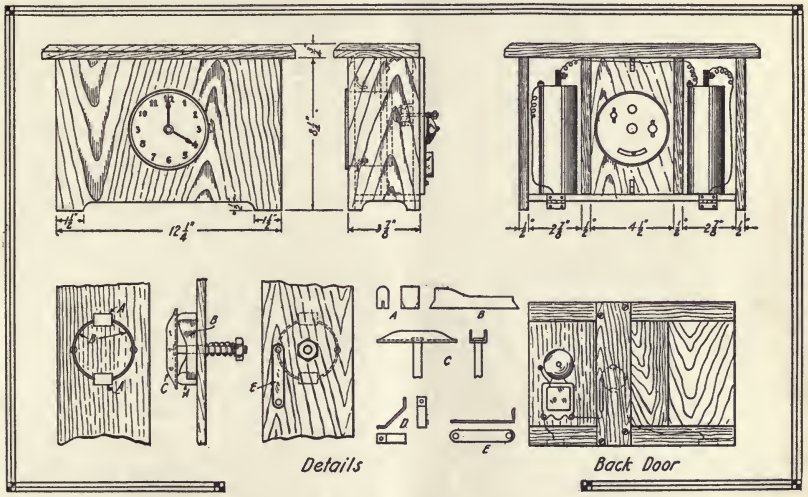
If you have an idea for this department, why not send it in? All contributions are paid for at space rates, with a minimum of $1.00 per idea.

AN ELECTRIC ALARM CLOCK

By G. M. Heinroth

An alarm clock of pleasing design and presenting the important feature of a continuous ring after it has been started, is described in this article. The clock may be made by any handy man with simple tools, and its usefulness amply repays the small expenditure of money for materials and the time involved in the construction.

In operation, the device is merely an ordinary alarm clock so combined with an electric circuit and bell in a suitable



frame or case that the winding key of the alarm clock closes a switch when the clock "goes off" and thus completes the circuit through battery and bell, making it necessary for one to arise and turn off the current in order to stop the bell from ringing.

The clock movement is prepared for fitting into the wooden case by removing the gong and its supporting rod, laying aside the latter for future reference. The appended illustrations will show the reader how the clock is fitted into the wooden case which is made of oak and nicely finished. The dimensions are, of course, given only as suggestions since the individual builder will naturally have to make his case of a size to conform with the size and shape of the clock he intends using.

For the front of the case the builder should select a good, straight-grained piece. The bottom edge is worked out as shown in the drawing. The face of the board may be smoothed up with sandpaper, the right and left hand edges mitered to form a good joint with the end pieces, and the hole cut for the face of the clock. This hole is best cut with a scroll or jig saw and for the sake of appearances it should be a good fit for the clock.

The end pieces may next be worked out and mitered to fit the front board. These pieces should be cut accurately to the same height as the front. In marking and cutting the end pieces, care should be taken to make sure that there is a right and a left side. Before fastening the ends to the front piece, the top

and bottom should be prepared as the mitered joint is not so strong as to permit of very much handling. In assembling the case, good glue should be used, and, supplementing this, slender finishing nails may be sparingly used in the mitered corners.

The clock is supported within the case by means of the angle irons shown in detail at *D* and in use by the dotted lines in the side elevation drawing of the completed clock. In locating the clock in the case, care should be taken to see that the face projects about ⅛ inch uniformly all around.

The attention is next directed to the partitions which separate the battery compartments from the clock chamber, and to the piece that fits over the rear of the clock between the two partitions. The two partitions are fastened to the backing piece and the whole then secured in place with screws in order that the clock may be removed for repairs should such be necessary at any future time. A hole is drilled through each partition near the top for the wire connecting the two battery cells to pass through.

The covering for the rear of the case is in the form of a door built up of four separate pieces. The sides are just wide enough to cover the battery compartments and about three inches less in height than the case. The difference in height is made up by a 1½ inch strip across the top and bottom, leaving the center of the clock part uncovered. The cover is hinged to the case at the bottom.

The electric bell is fastened to one side of the opening on the cover and a wire connects one terminal of the bell to one hinge. The other terminal is connected to the switch and contact device which receives attention next. This device consists of two pieces of copper, brass or tin cut to the shape shown at *B* and bent in the form of half circles which are fastened to the piece of wood that closes up the opening left in back of the clock. At the termination of each copper piece, a small block of wood or fibre cut as shown at *A* is secured to provide the insulating segment on which the contact maker may rest when the device is set. The contact maker is shown at *C* and the reader will note that it consists of a piece of metal bent up into the form of a trough which is to fit over the winding key of the clock. A stud is securely fastened to the trough and made to pass through a hole in the wooden backing piece, where it is held by means of the coiled spring and nut. The contact maker should turn without undue friction, but at the same time it should make a firm contact with the copper strips when turned off the insulating blocks. The switch is merely a short strip of metal bent up as shown at *E*, pivoted at one end and making contact with the head of a screw that terminates in a soldered joint on one of the copper strips. The second strip is connected to the hinge on the right hand side. The remainder of the connections are shown clearly in the drawing of the back of the case with cover removed.

It is understood that the height of the contact strips, the insulating blocks and the sides of the trough or contact maker are necessarily dependent upon the size of the clock movement. The idea is to have all dimensions of such a value that the trough will fit over the winding key when the device is set. When the alarm rings, however, the trough should slip into the depression in the contact strips, releasing the key in order that the latter may continue in its revolution without again bringing the contact maker into the insulated position.

The operation of the device is obvious. By letting down the back on its hinges, the clock is exposed for winding and setting and in replacing the back, it is only necessary to see that the contact maker is in a vertical position and resting on its insulators while the alarm key is in a similar position in order that it may enter the trough when the cover is closed.

Increasing use of the national forests by local farmers and settlers to supply their needs for timber is shown in the fact that small timber sales on the forests numbered 8,298 in 1914, against 6,182 the previous year.

A CRAFTSMAN LIBRARY TABLE

Describing the Construction of an Attractive Library Table, and Discussing Oak as a Cabinet Wood.

By Ralph F. Windoes,
Instructor in Manual Training, Davenport, Iowa

Illustrations from drawings made by the author.

THERE is no other article of furniture that appeals as strongly to the major of Home Craftsmen as a library table. One reason for this, perhaps, is the exorbitant price asked by dealers for such tables of good design and construction—$25.00 being the lowest, generally, of quarter-sawed oak. If the craftsman purchases carefully, he should be able to obtain the lumber and materials for the same table for $7.50 or $8.00, while the joy derived from the creation of such a piece will surely make it a worthy project for his endeavor.

As hinted above, quarter-sawed oak is the best wood to use, beyond a doubt, as its beauty of grain and markings when properly finished places it in a class by itself. It is altogether fitting, then, that we give this peer of American hardwoods a few words of discussion at this point.

There are over fifty distinct varieties of oaks in this country, which are roughly divided into two groups—the white and the red. Generally speaking, the white oak trees may be distinguished by their acorns, which ripen in one season, and their leaves, which have well rounded lobes. The acorns of the red oaks ripen in two years, and their leaves have sharp points, while the fingers of the leaves are indented again with smaller teeth. Hence, a study of the trees will enable one to readily distinguish between the two groups. But this does not assist much in deciding which is which when it comes to the cut lumber—and it is here that the craftsman finds his interest centered.

About the only way in which the lumber of the two classes can be distinguished is by a careful study of the end grain. In Fig. 1, at *A*, we see the end of a cut log with the names of the most important parts. From the center, called the *pith*, we see lines radiating toward the edges. These lines are known as *medulary*, or *pith, rays*, and cause the "flake" to appear on the surface of a board when it is quarter-sawed. Parallel to the bark we notice a series of rings, known as *annual rings*, running around the log. One of these rings is formed each year, and it is by means of them that the woods may be distinguished accurately. A careful study of Fig. 2, which is a greatly enlarged section of the

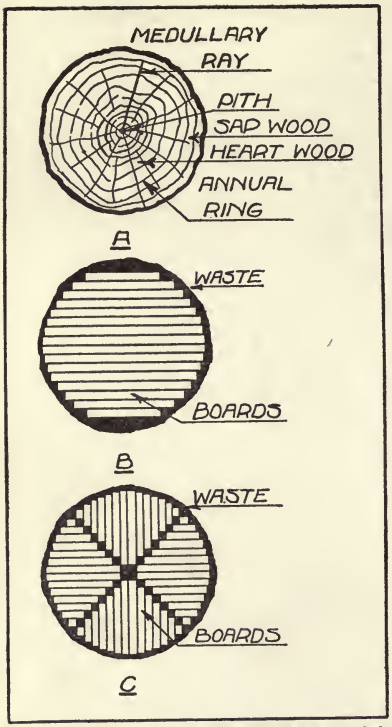


Fig. 1.—The Structure and Methods of Sawing Oak for Furniture Making.

two woods, shows each ring to be divided into two parts—large pored wood, or spring wood, and close pored wood, known as summer wood. This means that in the spring when the sap is flowing rapidly, the pores formed are large and open, but in the summer and fall, when the growth is much slower, the pores are smaller and closer together. Now these *small* pores, in the white oaks, are so numerous and closely packed together that it is almost impossible to count them, while in the red oaks they are few in number and are easily counted. Hence, by a study of the woods, they may be distinguished. Of course, you will not be able to note these pores with the naked eye, so some sort of a microscope will be necessary. One of the small pocket magnifiers, which can be purchased at a reasonable cost, will suffice, and, together with a very sharp knife or chisel with which to pare the wood so that the fibers are not broken, will comprise the necessary equipment for studying the wood.

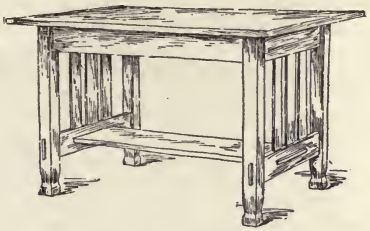
While this microscopic method is the surest way of determining various kinds of wood, lumber men almost universally group light colored oaks that work like true white oak, and call them white oak, while all other oaks are placed in the red oak group. Color, then, is one of the marks of distinction, but this cannot be relied upon, as the sap wood of some of the red oaks is lighter than the heart wood of the white. The red, as a general rule, is more elastic, but it is not as heavy or as hard as the white, which characteristics assist greatly in distinguishing between the groups.

For cabinet making, the red oak is easier to work than the white, but has a coarser grain and is more liable to shrink and warp—hence white oak is recommended for all furniture building.

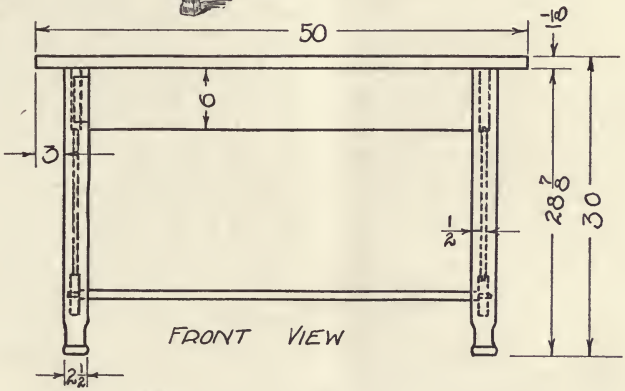
Referring again to Fig. 1, we find at *B* one method of sawing up a log so as to produce plain sawed lumber—the black portions of the drawing representing waste. At *C* is illustrated a method of cutting so as to produce quarter-sawed lumber. The log is first cut up into quarters, and then each quarter is sawed into boards so that the medullary ray may be visible on the surfaces of the boards, causing the beautiful "flake." The drawing also illustrates the amount of waste from this method of sawing, which accounts for the higher price of quartered over plain.

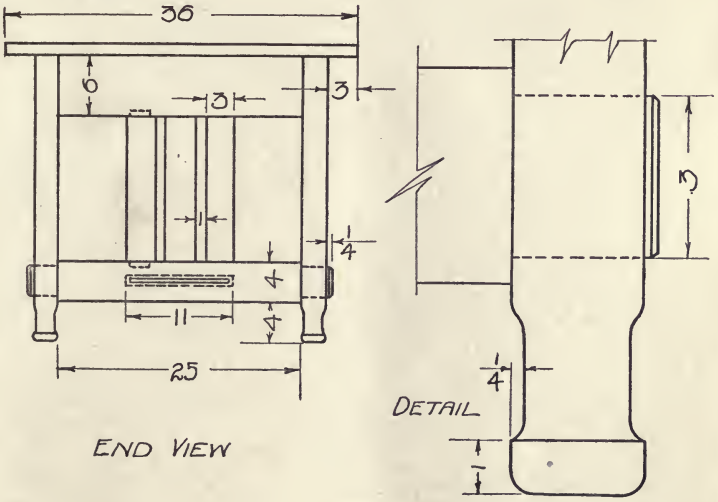
The lumber for this table should be purchased as follows, planed and sandpapered to dimension at the mill:

Legs, 4 pcs., 2½" x 2½" x 28⅞", plain oak.
Side rails, 2 pcs., ⅞" x 6" x 43", quarter-sawed oak.
End rails, 2 pcs., ⅞" x 6" x 29", quarter-sawed oak.
End stretchers, 2 pcs., ⅞" x 4" x 30½", quarter-sawed oak.
Shelf, 1 pc., ⅞" x 11" x 43", quarter-sawed oak.
Top, 4 pcs., 1⅛" x 9½" x 52", quarter-sawed oak.
End slats, 6 pcs., ½" x 3" x 16", quarter-sawed oak.



LIBRARY TABLE





Working Details of the Library Table Described in the Accompanying Article, as Well as a View of How it Appears When Completed.

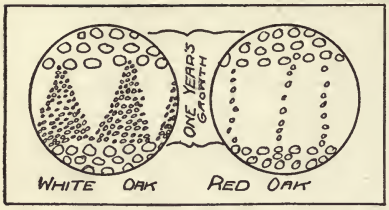


Fig. 2.—Distinguishing Marks of the Different Kinds of Oak.

Begin the construction of the table by laying out the mortises in the legs. To do this correctly, select the two poorest faces that are adjacent for your *working faces.* That is, the corner where these two faces join will be the inside corner of each leg when the table is assembled, and it is on these faces that the mortises will be layed out. Be very sure that you *check* these faces so that no mistake will be made in the work that is to follow. Mark the joints out roughly with pencil and place the four legs into position on the floor so that proper mortises face each other. While in this position, mark them on the ends Nos. 1, 2, 3 and 4, so that you will be able to place them in the correct order later on. From the *checked working faces,* lay out the work very accurately with the marking gauge, knife and try-square. Notice that there will be no mortises for side rails at the lower ends of the legs, and that the stretchers are through tenons; these joints being laid out on both sides. When carefully finished and tested, bore holes between each set of lines and chisel out the cheeks, as has been explained before in this series.* On the through tenons the holes are bored into the center from both sides and the chiseling is worked from the opposite edges. The mortises in the legs for the side and end rails are ½ inch wide, 5 inches long, and 2 inches deep.

When the mortises have all been cut, lay out and chisel the little recesses at the bottom of the legs, as illustrated in the detail. Sandpaper these carefully so that no chisel marks remain to be seen.

Next, cut the tenons on the side and end rails to fit snugly into their respective leg mortises. Be very sure that the distance between shoulders on the like pieces is exactly the same. Following these you should cut the long tenons on the stretchers. As the ends show, this work must be very carefully done or an unsightly crack will show on the faces of legs. Chamfer these stretchers a little on their ends.

Now the mortises should be layed out and cut for the end slats. They are located in the top edges of the stretchers and the bottom of the end rails. When completed, fit the slats into them and cut the mortises for the bottom shelf. These will be worked from both faces as the tenon runs through. In fitting this tenon cut the shoulder distance a little long and then pare it down to fit after the table has been clamped up dry. If all of these parts go together nicely glue the tenons and clamp to dry. The whole table may be put together at once, or the ends may be clamped singly.

After all visible glue has been removed, joint up the boards for the top. If the craftsman has not had the experience or does not care to take the time for this, he may order the top all glued up and sandpapered to dimension at the mill. Of course, this will cost him much more than the separate boards.

To joint the top you should have a 22 inch or a 24 inch jointer plane. Be sure that the bit is straight across the cutting edge—and sharp. Place the four boards in the position that you wish them to occupy when completed, and mark them so that you can tell this position as you are jointing the edges. Take one board

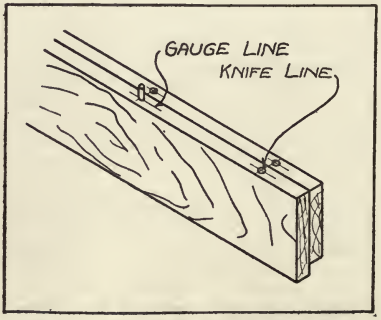


Fig. 3.—Method of Doweling the Table Top.

*See January number of MODERN MECHANICS.

and plane it as near straight and square as possible, running your plane straight with the edges of the board so that you will be sure to plane out all "hills and hollows," and not be low on the ends. When this is finished, place the board, which is to be joined to the first one, in the vise and plane this edge in the same way. If both edges have been correctly planed you may now place the first jointed edge on top of the second and no light should show through. If light is visible through the joint, mark the high spots and very carefully plane them off. Repeat this with the three joints, and you will be ready to dowel the top, as explained further on.

As suggested in Fig. 3, clamp two pieces together so that the edges which will be joined are uppermost. With the marking gauge, lay out lines in the center of each and cross these lines with the knife and try-square mark at right angles, as shown in the drawing. Where these lines cross on both pieces, the joints of crossing will be exactly opposite when the boards are put up into position.

Next bore holes at each point with a ½ inch bit, making them about 1½ inches deep. Bore them perfectly straight and of equal depth so that the pins will be interchangeable. The latter should be about 2¾ inches long and pointed a little at the ends. The pins should slip in easily into the holes and not have to be driven.

If hot glue is available and the workman has had enough experience to handle it rapidly, it is much better to use for this work than the cold, but if the latter is used, allow it to stand about fifteen minutes before clamping.

When the glue has set, scrape it off and plane the top down as nearly smooth as possible. Then scrape and sandpaper it until every rough spot in the grain has been removed and trim the edges and ends of the piece.

Fasten the top to the frame with angle irons or table top irons that can be purchased at most hardware stores. The latter are to be preferred, as they allow for expansion and contraction of the top with changes in the weather.

The finish for a table of this kind should consist of stain, filler, shellac and wax—processes that have been discussed so often in this department that they will hardly bear repetition.

EXTINGUISHING FIRE WITH SAWDUST

A SUGGESTION that an inflammable material be used to extinguish fires may excite ridicule, since the popular idea of such extinguishers refers to water, sand, carbon tetrachloride or carbon dioxide gas.

However improbable the suggestion may seem, facts to prove its practicability are at hand.

Quite recently the Stanley Works of New Britain, Conn., reported through the Manufacturer's Mutual Fire Insurance Company's office that extensive experiments conducted at their plant on extinguishing burning lacquer by the use of sawdust had been extremely successful. The insurance company could scarcely credit the report and requested that new tests be made in the presence of their experts. This request was readily granted and the tests were absolutely convincing.

Tanks were built out in the open and filled with lacquer up to six inches in depth. A stiff wind was blowing. After igniting the lacquer and letting the blaze get full headway, the sawdust was thrown evenly over the surface with a long handled snow shovel. The largest tank was 60 inches long, 30 inches wide and 16 inches deep. A representative test was one in which a two inch layer of lacquer was allowed to burn one minute and two seconds and the fire was then completely extinguished in eleven seconds by the application of only two shovels of soft wood sawdust. In order to utilize the extinguishing effect of car-

bon dioxide a mixture of ten pounds bicarbonate of soda in a bushel of sawdust was tried. A two inch layer of lacquer was allowed to blaze for one minute and eight seconds, following which it was easily extinguished with one shovel of this mixture in nine seconds. Obviously, the heat released carbon dioxide from the bicarbonate and this acted as a blanket on the flame. In fact, tongues of flame could be seen shooting out from under the layer of gas. The absence of wind indoors would doubtless give still better results.

To make the test more difficult a wooden platform five feet square was built with a two inch rim and a fire of lacquer allowed to burn on it for 45 seconds. The conflagration was extinguished with three shovels of sawdust in 53 seconds. The next test was with the same platform, attempting to extinguish the blaze with a three gallon chemical fire extinguisher, but with no better results. Had it not been for the rim of the platform the force of the stream would have spread the burning lacquer.

Motor gasoline was also used instead of lacquer in a tank 30 by 12 inches. A vigorous blaze in this was promptly extinguished with two shovels of sawdust in 12 seconds. Sand had but little effect on gasoline burning in a layer of appreciable depth, but it did fairly well when applied to gasoline burning on the ground.

The following conclusions seemed warranted by the tests:

Sawdust, spread over the surface, will readily extinguish fires in inflammable liquids such as lacquer and gasoline when contained in such moderate-sized tanks as those ordinarily used in manufacturing plants.

The efficiency of the sawdust is due to its blanketing action in floating for a time upon the surface of the liquid and excluding the oxygen of the air. The sawdust itself is not easily ignited and even so its burning embers do not reignite lacquer.

The character of the sawdust, whether hard or soft wood, common or dried, is of no importance.

When the sawdust is applied rapidly so as to put out the blaze before the sawdust has time to sink, the depth of inflammable liquid is of no importance.

Sand is not satisfactory as an extinguisher for fires in liquids contained in tanks or vats, because the sand sinks to rapidly. With a liquid burning on the ground, sand is more effective for obvious reasons. However, it is no better even then than sawdust and is heavier and more awkward to handle.

The mixture of sodium bicarbonate with sawdust is most effective because of the release of carbon dioxide which adds to the blanketing action of the sawdust.—HENRY M. HOLMES.

ELECTRICITY ON A CALIFORNIA RANCH

The simplicity and ease with which electric current can be applied to farm work, particularly when the farm is within reach of a transmission line, are exemplified on the large certified dairy farm of H. R. Timm in Solono County, Calif.

Mr. Timm's ranch has about 300 acres of alfalfa which is used for dairy cow feed. He has two silos which each hold 500 tons of ensilage, and he fills them both with green alfalfa for silage, when he is harvesting the last crop of alfalfa of the year. The green alfalfa is run through a regulation corn ensilage chopper which is operated by an electric motor.

Similarly, during haying time, Mr. Timm runs dozens of tons of alfalfa hay through the ensilage cutter and stores it in the hay barn. By chopping up the hay Mr. Timm succeeds in scoring two points of economy. The cattle eat the hay with little waste when it is chopped —they clean up all the stems—and the chopped hay goes into the barn in more compact form, giving the barn greater storage capacity.

The corn ensilage cutter is driven by a seven horse-power electric motor, and corn or alfalfa ensilage or dry hay can be chopped at the Timm dairy farm at a very reasonable cost.

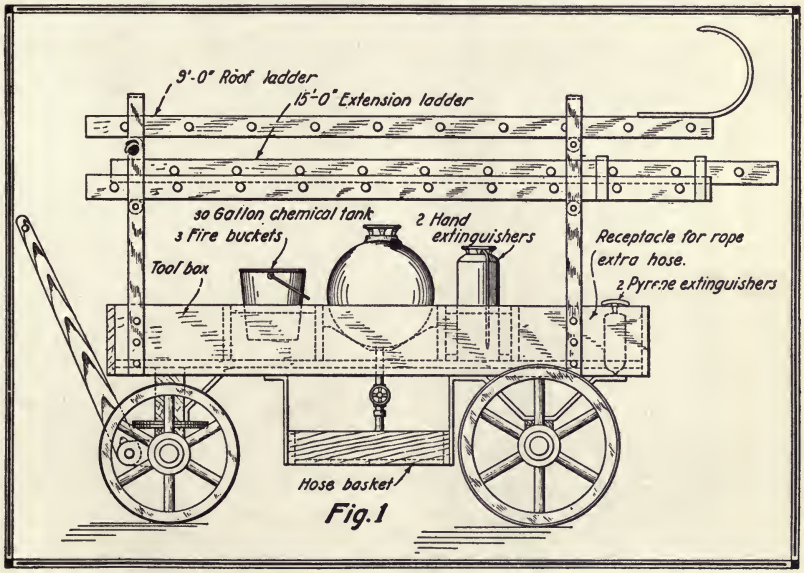
A Chemical Fire Truck for a Village

by F. B. Hays.

IN villages serious conflagrations often arise from small and unimportant fires that might readily be extinguished if some suitable fire-fighting equipment were at hand. In the following paragraphs the author has endeavored to give a few essential details for a chemical fire truck which not only will serve efficiently for fighting conflagration in small villages, but will also be a valuable safeguard in any factory or manufacturing plant.

In Fig. 1 is shown the fire wagon complete. The wagon is intended to be hand-drawn and may be built at a cost of about $150 by any competent blacksmith, wagon wright or carpenter. The wagon comprises a complete fire department in itself and is capable of extinguishing the average small fire.

The equipment for the fire wagon consists of the following: One nine-foot ladder; one fifteen-foot extension ladder; one thirty-gallon chemical tank; two three-gallon hand chemical extinguishers; two Pyrene extinguishers; two lan-



The Chemical Fire Truck as it Appears When Completed. Modifications May be Made in the Equipment to Suit the Requirements of the Builder.

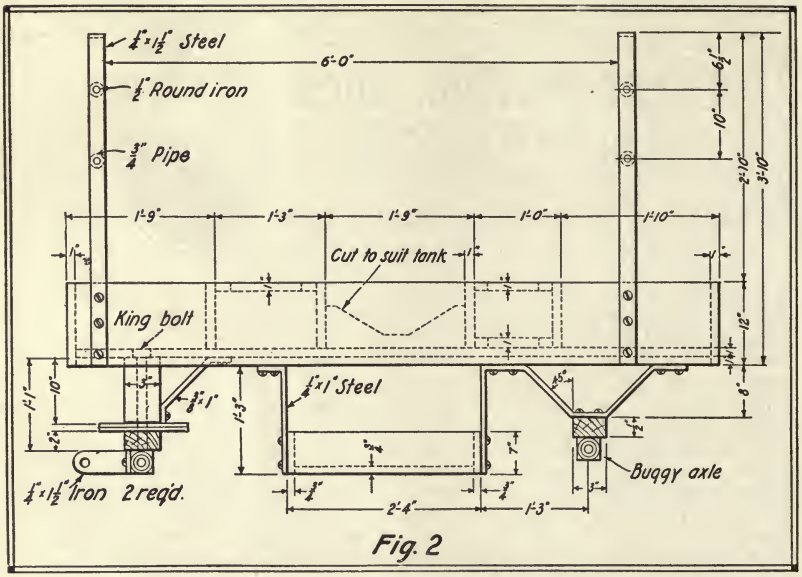


Fig. 2

Above: Side Elevation of the Framework and Truck of the Chemical Fire Engine, Showing the Necessary Woodwork and Ironwork.

Below: Top View of the Framework and Truck of the Chemical Fire Engine, Showing the Arrangement of the Holes, Compartments and Racks for Holding the Buckets and Other Equipment.

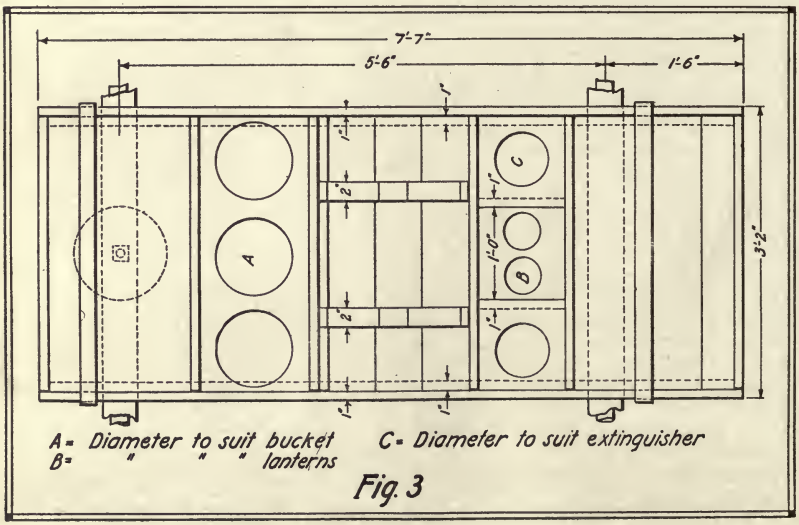


Fig. 3

terns; three three-gallon fire buckets; 250 feet of one-inch rubber covered hose; 50 feet of one-half inch hemp rope; two fire axes; one thirty-inch pinch bar; one small hay fork and one short pike hook.

The ladders, chemical tank, extinguishers, hose and other necessities can be procured through the local hardware dealer. The wheels and axles can be taken from an old buggy or cart. The wheels should be as low as possible, as indicated in Fig. 1. Figs. 2 and 3 give the dimensions and details for building the wagon.

The total weight of the fire wagon when completed should be in the neighborhood of 500 pounds and can readily be handled by one man. Aside from its uses in small villages and in factories, it will also be found a source of protection on any large farm.

USING THE X-RAY TO EXAMINE EUROPEAN SHIPMENTS

The use of the X-ray by the British government in examining a cargo of cotton consigned to Bremerhaven, Germany, on a North River dock in New York City, during Christmas week, was a sensational demonstration of the practical usefulness of this comparatively young branch of electrical science in applications outside of hospitals and surgery in which it is best known to the public.

No copper or other contraband of war was found, and the ship will be spared the detaining hand of Great Britain's traffic policemen of the high seas by virtue of the New York British consul's certificate of inspection.

The most powerful type of the Wappler radiographic machine was mounted on the shipping dock, and about every tenth bale of ten thousand was examined by a British consulate inspector stationed on the opposite side of the bale from the X-ray tube. The latter was swung a few feet from the standard on which were placed the X-ray apparatus, the rotary convertor and the step-up transformer, as well as the "inch meter" by which a convenient reading for maintaining the spark at about five inches is obtainable. The tube was applied close to the parts of the bales that were selected and brought to a platform in front of the machine. The inspector saw to it that the X-rays passed through the cotton uninterrupted by copper or other contraband; a test very similar to that of a physician searching for a bullet in a wound.

The installation of the apparatus was in charge of Prof. Davis, of Columbia University, and his assistant, Dr. Weber. A copper screen shielded the operator from possible X-ray burns while operating the switchboard on which were mounted the control and regulating devices. Provision was made to have the X-ray tube kept at a safe heat even with the constant use. A canvas screen was employed to shut off bright daylight from the whole outfit in order that the examiner's vision might not be disturbed from his scrutiny of the X-ray effects.

The initial current was 110 volts from an ordinary direct current circuit. This was converted by a rotary transformer to about 75 volts, alternating current. The high tension transformer delivered a range of 15,000 to 120,000 volts. The selector and regulating apparatus, once set, required little attention, although the current to the X-ray apparatus proper was switched on and off with each examination of a bale. The rotary transformer was about 3 kw.

BIMETALLIC ACCUMULATORS

MANY attempts have been made to produce a satisfactory form of storage cell employing other chemicals than lead plates and sulphuric acid. Thomas A. Edison performed no less than 9,000 experiments before he perfected his present type of cell.

It is of interest to note a few of the bimetallic cells that have been tried out, but which on account of many inherent defects have not been of any commercial value. However, the casual experimenter or student might find much food for thought in the description of them, because some of the cells have many good qualities which are not to be lost sight of.

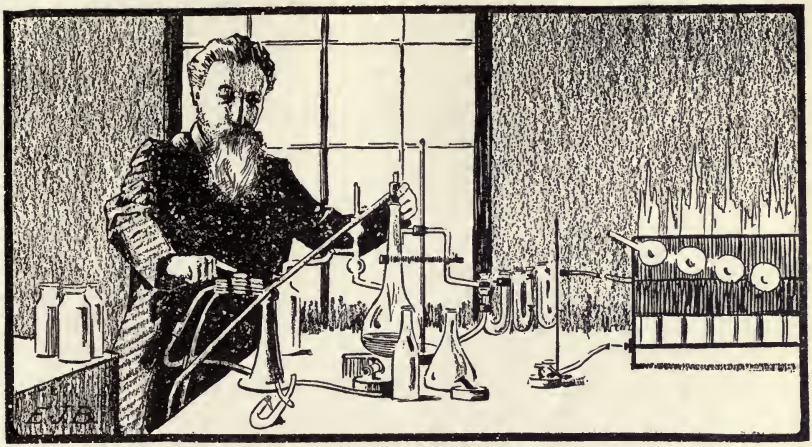
The simplest form bimetallic cell is the zinc-lead cell which employs positive plates of lead and negative plates of zinc in a solution of zinc sulphate; the action taking place during charging is the depositing of zinc upon the zinc plates and the forming of peroxide of lead upon the lead plates, the solution being decomposed into sulphuric acid. It is obvious that while the battery is charged and upon open circuit there is bound to be some local action taking place and unless the zinc is heavily amalgamated a charge will not be retained long. The E. M. F. of such a cell is quite high, about 2.5 volts, and is not very constant, ranging from 2.5 volts when fully charged to 1.5 at the end of the discharge.

A cell somewhat similar to that just mentioned is the copper-lead cell in which copper is substituted for zinc, and copper sulphate for the zinc sulphate. In this cell the local action is diminished, but the E. M. F. is considerably lower, being about 1.2 volts.

A few years ago a cell was put on the market using the same active material as the well-known Edison-Lalande primary cell, modifications being made to adapt it for use as a storage battery. It comprised a copper plate for the negative element and a thin steel plate for the positive element, in a solution of caustic soda and potassium zincate. The reactions taking place are somewhat complicated. While charging, zinc is deposited upon the steel plate and copper oxide is formed upon the copper plate; the reverse action taking place during the discharge. The E. M. F. is low, being about .75 volt. The watt output, however, is large, being about five times that of a lead cell of equal weight. The rate of discharge does not seem to effect this cell, and buckling of the plates is practically unknown. The great defect that handicaps this otherwise admirable cell is varying efficiency at different temperatures. In order to work most satisfactorily the cell must be kept at a temperature of 130 degrees Fahrenheit.

Many attempts have been made to produce a cell in which the above mentioned defects are eliminated, but these attempts have ended in failure or have been given up as impractical. Edison, however, has succeeded in producing a bimetallic cell in which the active material is peroxide of nickel for the positive plate, and finely divided iron for the negative plate. The electrolyte is a solution of caustic potash. The E. M. F. at discharge is about 1.5 volts. This type of cell has many of the good qualities of other bimetallic cells, but none of their defects. It has proven superior in many cases to the lead and sulphuric acid cell, and weight for weight it has a greater capacity and is more durable. But as the inventor himself has said, this is by no means the last word in storage batteries. In fact, he sees no reason why a cell could not be developed that would be far more efficient and durable than the present types of storage batteries now on the market, and when it does come it undoubtedly will be of the bimetallic type.—RICHARD G. WHIPPLE.

Success has followed forest planting on the sandhills of Nebraska. Jack pines planted there by the Government forest service ten years ago now have a height of over 15 feet and a 4-inch diameter.



In Practically Every Large Manufacturing Plant Where the Tempering of Steel Is an Important Factor, a Chemical Laboratory for Testing the Product Is a Paramount Necessity.

Plain Facts on Hardening Steel

By W. E. Thompson

THE hardening plants of all well systematized concerns are, without exception, equipped with some type of pyrometer for measuring the heat at which parts are to be hardened. Many concerns have all the different types at hand for checking purposes, but this is not necessary where a limited amount of work is handled. These concerns realize the value of the instruments, else they would not invest in them.

There are, however, hundreds of small shops, and some medium sized plants, that are losing a large percentage of parts, either by the development of cracks or deformations upon hardening; or having trouble with the parts after assembling due to a variation in the hardness of different lots carried through. The writer has found this to be the case many times and has also experienced considerable trouble convincing the owners that they needed a heat measuring instrument.

In one shop, making a specialty of small tools and dies, over 50 per cent. of the work was being spoiled by cracks, deformations, burning, or by reheating to unreasonable temperatures on account of failure to harden at the first trial, before the installation of a pyrometer. This loss was cut to 5 per cent. by measuring the heat. This was a case where each man did his own hardening, a gas furnace being used for heating. When the pyrometer was first installed, some of the hands were found heating straight carbon steels to a temperature of from 1800° to 2000° Fahr., and when asked their reason, stated that "the piece did not look hot enough to dip" when the gauge hand registered 1400°, (this being the heat recommended for the particular brand of steel being used). After

all hands were convinced that it was better to depend upon the meter than their own judgment, burned or improperly heated steel became only a matter of carelessness.

In another case, each man was hardening his own work in a modern gas furnace set close to the windows on the south side of the room, with only white curtains to cut down the light on bright days. Their experience had been that on some days the work would go through with little or no trouble (those days were rare), on other days the work would not harden thoroughly the first time dipped, and at other times nearly every piece would crack. Fifty per cent. of the work was being scrapped in this case also. In spite of this condition, it was six months before the firm would have a pyrometer put in. They finally had one in on trial, the loss was cut to 5 per cent., and to-day they would not attempt to harden without one.

In every place where an instrument was installed, it not only saved its cost in a short time but also made the hardening operation as easy as telling time by the clock. Faster and better work was the natural result and the strained look came off the toolmakers' faces. There is nothing more demoralizing to a tool or diemaker than to make parts over after fire cracking. It is just as reasonable to expect men to make fine tools with no measuring instruments as it is to expect them to heat steel properly without the proper temperature indicator. Poor results will be obtained in either case.

The writer has used electric, hot-blast, and sight or optical pyrometers with uniform success. Some care is needed when using an electrical instrument, to keep the electrical connections clean when the terminals of the cable connecting the thermo-couple with the meter are made of brass, as these oxidize rapidly, showing less heat at the meter than is actually produced in the furnace. These terminals should be made of copper to eliminate this trouble. Another trouble found when using the electrical pyrometer is the wearing away of that part of the tube enclosing the thermo-couple, which stays in the furnace, caused by the oxidization of the iron. When this occurs, the couple may be cut off, the ends twisted together and brazed, the enclosing tube cut off and tapped, and a new plug screwed into the end. The hot blast pyrometer gives little trouble but it is not as desirable to use for general work as the electrical method. The sight instrument is, without doubt, the most reliable meter, but requires more care in handling to prevent breakage, so is not as economical for general use as one fastened in its place permanently for that reason.

After the installation of a gas or oil furnace and a pyrometer, a set of rules, with a complete table of critical heat temperatures for all the different steels in use in the plant, should be placed within easy reading distance of the furnace. The following rules apply to any furnace used for hardening tools, dies, or other parts made of steel or high carbon steels, and should be followed to get the best results.

GENERAL RULES FOR THE USE OF THIS FURNACE

1. Do not use any cyanide or other case-hardening mixture in this furnace.
2. Do not heat any copper, brass, german silver, or other metal than iron and steel in this furnace as the fumes of such metals are injurious to steel having a high carbon content.
3. Boracic acid may be used in the smallest possible quantity to prevent the surface of steel scaling.
4. Parts to be hardened should be placed in the furnace when cold or at a temperature not exceeding 800° Fahr.
5. The full heat should not be applied when starting. Better to regulate the burners to about half blast and let the furnace heat gradually.
6. When the pyrometer registers the desired temperature, the burners should be regulated to maintain this temperature until the work is thoroughly heated.
7. Steel may be quenched in any conventional bath, but a method preferable for dies and parts liable to crack is—

   Dip the piece in clear water until all vibration ceases, then quickly into oil at 300° Fahr. The part should then be drawn to the desired temper in oil before it goes below 300° Fahr.

8. Dies or any part containing a depression in the surface should be dipped with this depression up.
9. Large pieces may be quenched in brine instead of water if preferred.
10. Prepare all work for hardening as much as possible by plugging holes unnecessary to harden.
11. Heat all steel to the proper temperature. See Table —.

A barrel of snow water, with a small percentage of salt in it, makes an excellent dip and improves with age. The use of vitriol should be discouraged—there is nothing to recommend it. Tool steel, properly heated, will harden thoroughly if quenched in clear soft water at ordinary temperature, provided enough water is supplied to cool the piece quickly. Brine is a slight aid when hardening large pieces but is not necessary. Small pieces may be dipped into cylinder oil at a temperature of 300° Fahr., and will harden as hard as necessary for all practical purposes. The danger of cracking or deforming is reduced by this dip. The temper should be drawn as usual after hardening in hot oil.

A good method to use for dipping all pieces liable to crack is that given in Rule 7. The steel is placed in the furnace cold or at a temperature not above 800° Fahr. While the work is heating, the oil drawing bath is brought up to 300° F. and kept at this temperature until after all the parts are hardened and in it. When the piece to be hardened is at the proper temperature it is dipped into the bath and held there until it can just be held in the hand under the surface of the water, it is then transferred quickly to the oil bath. When the hardening is all finished, the oil bath is raised to the desired temperature, by a thermometer, thus drawing all parts uniformly. This method reduces the chance of cracking to a minimum for the following reason: Steel, as a rule, develops cracks after it has cooled below 300° F., due to tremendous strains set up internally that are later relieved by drawing the temper, or in other words, raising the temperature of the whole piece to a point whereby these strains are equalized. The above method prevents these

The Heat of a Flame Cannot Be Determined by the Human Eye; a Pyrometer is Essential for Accurate Work.

strains reaching a dangerous point.

The idea of dashing work from the fire into the bath is wrong, although a large percentage of workmen do this. It is generally well known among steel men that when a piece of steel, heated to a predetermined temperature, is taken from the furnace into the air, the surface of the steel rises suddenly to a higher temperature than the inside, then begins to fall again. With the exception of thin or very small pieces, liable to be air-cooled, the heated parts should not be dipped within one minute from the instant they leave the furnace—that is time enough for any work except very large pieces. If this policy is followed less cracking will result.

It is generally safe to dip small pieces of straight carbon steel at about 1400° F.—alloy steels at 1450°—and oil hardening steels at 1500° Fahr. Large pieces should be dipped at 25° to 50° higher.

The average workman labors under the impression that if a steel will harden at 1400° of heat, it should not be heated any higher. This is another mistaken idea. The makers, going to considerable

expense, obtain the best or critical hardening point of every grade of steel that they make and their instructions should be carefully followed, regarding the heat, to get the best results.

The hardening of small saws or very thin pieces may be accomplished by heating as usual and cooling between two comparatively large pieces of iron or copper, having their clamping faces the shape of the hardened piece, if not flat. If a large number of pieces of this kind are to be hardened, the jaws may be held by a frame and operated with the foot as in large plants, but if only a few pieces of this nature are occasionally required, the clamp irons may be handled by a helper when the hardener brings the work into place between them. When the work is hardened flat, as small saws and blades, the lower jaw is preferably laid in oil that just covers the face of the jaw. The saw is dropped flat on this face and the upper plate brought down quickly, the oil helping to absorb the heat. This is the only practical method of getting thin pieces hard and flat.

The tool steel furnace should be kept clean—this is very important. Cyanide of potassium and other case hardening mixtures not only spoil the lining of the furnace but also throw off fumes injurious to the tool steel and workmen alike.

Copper, brass or German silver should not be heated in the furnace as they also throw off fumes very injurious to high carbon steel, and the effects last even after the visible metal is removed. Sulphurous fumes are one cause of soft spots and nearly always prevent clean work.

Boracic acid is probably the best preventative of scale known for commercial use and it will not hurt the furnace if kept away from the lining. It is good practice when using the furnace to lay a piece of sheet steel on the floor of the heating chamber and the part to be heated on this plate; the boracic acid will run onto this plate which is easily cleaned.

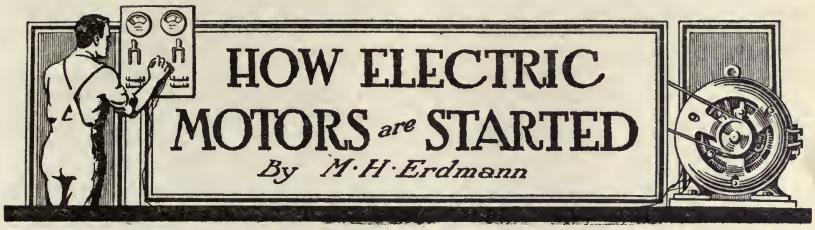
High speed steels, when intended for cutting tools, require to be hardened at a high heat, but when intended for hammering, swaging or striking dies may be hardened at about the same temperature as straight carbon steels. In either case, crystal borax used to prevent oxide forming is better than boracic acid for the protection of this kind of steel. Any borax adhering to the steel after dipping can be removed by placing the part in boiling water for a short time.

Dies and tools having a number of tapped or dowel holes should have these holes plugged with chalk or other non-burning filler. This prevents strains running across the surface strains and thus causing fractures.

In closing this article it might be well to state that although hardening is a purely mechanical operation, it is the most important of any in the making of tools and dies. The highly systematized plants appreciate this fact, and their chief hardeners are among the highest salaried executives. In the small shops, however, there is more chance to save on this operation than on any other, as, with exceptions, the owners either do not appreciate the importance of proper heat treating methods or do not know how to improve their condition. With the exception of seams in the rough steel, for which the makers are responsible, there is a reason for every crack. These troubles may be eliminated or reduced to a very low factor by a careful study and application of the information issued on this subject from time to time.

There is a way to successfully treat every case, but the application depends upon the man, or, rather, the development of his gray matter, as no set of rules ever issued will cover all cases. It is but another case where the human factor is the all-important agency in the successful performing of the work.

The forest service is co-operating with 54 railroads, mining companies, pole companies, and cities in making tests of wooden ties, timbers, poles, piling, and paving blocks which have been given preservative treatments.



HOW ELECTRIC MOTORS are STARTED

By M·H·Erdmann

TO attempt to describe in even moderately minute detail all the different types of direct current motor starters on the market today would necessitate a paper the reading of which would take up the greater part of three or four hours. In this paper, however, I shall endeavor to describe briefly the more common types that are in use and the various principles under which they operate.

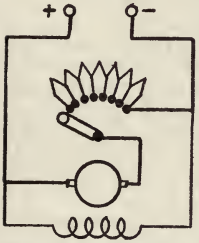


Fig. 1.—Connections for a Motor Starting Rheostat.

Wherever direct current motors of a larger horsepower than one-quarter are used it is advisable to employ some sort of a starting device to accelerate them, by means of which an external resistance in the motor circuit is gradually decreased until it is entirely cut out and the motor is receiving full line voltage at its terminals.

There are several methods of accomplishing this end, the original being to step-by-step short circuit the external or starting resistance by hand. The simplest way to do this is through the use of what is commonly known as a motor starting rheostat, a simplified connection diagram of which is shown in Fig. 1. There may, of course, be added to this starting rheostat such refinements as no-voltage release and overload protection, but the principle of operation is the same in any case. But at best this method is more or less unsatisfactory when applied to motors of say above 10 horsepower—unless a competent man is employed to start the motors—due to the fact that there always exists the tendency to accelerate them either too rapidly or too slowly. If the tendency is toward too rapid acceleration the current drawn by the motor will be excessive and either the line fuses will be blown or the motor windings will in time burn out. On the other hand, if the motor be accelerated too slowly the starting resistance, not generally being proportioned for continuous duty, will burn out. If the starting of large motors is to be done manually it is highly imperative that an ammeter be placed in the circuit and that an educated electrical man be instructed to watch the ammeter while he is accelerating the motor so that the current drawn from the line will not reach a dangerous point and that it does not flow through the starting resistance for a long enough

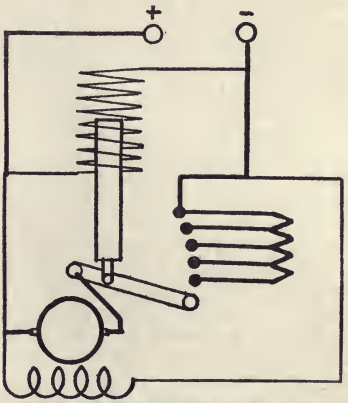


Fig. 2.—Diagrammatic Scheme of a Simple Automatic Motor Starter.

period to cause damage.

But think what such a procedure would mean in some plants where hundreds of motors are used and where a large percentage of them are each connected to an individual machine! It would mean the employment of a large corps of men whose sole duty would be to start and stop those numerous motors, in some cases many times a day. This is entirely out of the question.

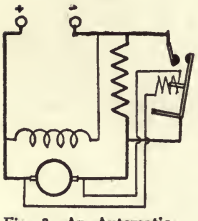


Fig. 3.—An Automatic Motor Starter Circuit.

The most expedient move, then, for the manufacturers to make is to install some type of automatic motor starting device whereby the motor under the control of each starter can be started, stopped or reversed by the mere pressing of a button or the throwing of one small handle.

When the need for an automatic starter became fully realized less than ten years ago by the manufacturers of motor controlling devices several types were developed. Among the first was what is commonly called the "dash pot" type, in which the plunger of a solenoid was mechanically connected to a pivoted arm which passed over segments on a slate base that were connected to the various taps taken off from the starting resistance. The plunger was prevented from being pulled up too rapidly by the action of the dash pot which could be adjusted to operate through a wide range of time units; *i. e.,* seconds or even minutes for very large motors having heavy loads to accelerate. See Fig. 2.

A slight departure from this type of starter is one which still makes use of the dash pot but gets away from the sliding contacts by utilizing a train of fingers to short circuit the starting resistance. These fingers are all fastened to one small shaft which is rotated through approximately twenty degrees by the action of the plunger in the dash pot. They are not rigidly fastened to the shaft but are so connected through the medium of springs that the shaft can twist slightly farther after the fingers have made contact. With such an arrangement provision can be and is made for the fingers making contact with their respective resistance tap lugs in a certain sequence. In other words, the starting resistance is cut out step-by-step.

It is a well-known fact that a pile of carbon discs or plates makes an ideal variable resistance, due to the fact that the surface contact resistance between the discs or plates varies inversely as the pressure applied. As the pressure is increased the total resistance of the pile decreases and vice versa. This principle is made use of by one of the manufacturers of motor controlling apparatus. The carbon pile resistance is connected in series with the armature of the motor exactly as would be a coil or cast-iron resistance. A dash pot is employed whose plunger operates a lever which increases the pressure on the carbon pile as the plunger pulls up. When the maximum pressure is reached an electrical circuit is established which short circuits the carbon pile and connects full line voltage across the terminals of the motor. With a starter of this type an absolutely uniform rate of current input increase to the motor is obtained by the use of the automatic starters described above.

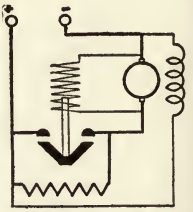


Fig. 4.—Another Automatic Motor Starter Circuit.

With a starter of this type an absolutely uniform rate of current input increase to the motor is obtained as against the step-by-step increase obtained by the use of the automatic starters described in the foregoing.

All dash pot types of starters have one very great drawback, however. This is the time element which is involved. With a certain adjustment of the dash pot the motor under the control of that starter will always be accelerated in the same amount of time no matter what the load may be. This is perfectly satisfactory

where the load to be started is always the same, but where the load is variable it is not so satisfactory. To accelerate a heavy load a longer time is necessary in order to keep the ampere input to the motor down to a safe value. Then again, when a light load is to be accelerated time is lost because the motor has time to attain full speed before the starting resistance is finally cut out.

An improvement over the dash pot type of starter is the one whose resistance cut out switches are actuated from the counter electromotive-force of the armature. As an accelerating motor increases its speed the counter electromotive force, if measured across the armature terminals, will be found to increase from zero as the speed increases, until at full speed when it is only slightly lower than the impressed voltage. Now consider a small solenoid-operated switch whose coil is so wound that it will pull the switch closed when the voltage across its terminals reaches a certain predetermined value. Then consider that this solenoid is connected across the armature of the motor and that the contacts of the switch are so connected that when the switch is closed it will short circuit a section of the starting resistance in the armature circuit of that motor. When the main line switch in the motor circuit is closed the solenoid has applied to its terminals a voltage equal to the counter electromotive force of the armature and, as the motor speeds up, this voltage increases until that value is reached at which the solenoid will pull the switch closed. In closing, the switch will short circuit the starting resistance and connect full line voltage across the terminals of the motor. See Figs. 3 and 4. If it is desired to incorporate more than one accelerating switch the coils of the following ones are so wound that they operate each at a higher voltage than the one immediately preceding it and all the coils are connected in parallel across the armature. Automatic starters employing the counter electromotive force principle have an advantage over the dash pot type in that the rate of speed increase of the motor being governed by the load and the rate of increase of the counter electromotive force being governed by the speed, it naturally follows that the time required for acceleration is automatically governed by the load. In other words, a light load is accelerated more rapidly than is a heavy one. This type of starter, however, has never been successfully applied to motors above three horsepower.

The ideal principle to utilize for accelerating direct current motors of any horsepower is what is called current limit acceleration, in which the current drawn by the motor during acceleration

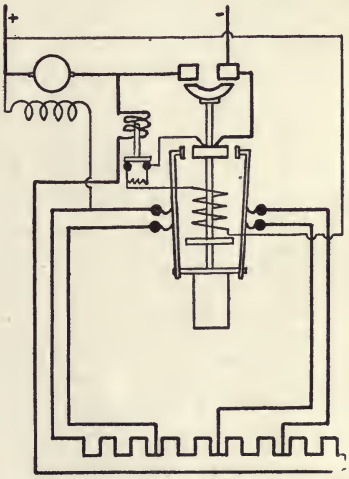


Fig. 5.—An Automatic Motor Starter Circuit in Which Current Limit Acceleration is Obtained.

automatically governs the proper length of time required to bring that motor up to full speed no matter if the load be light or heavy.

A rather unique type of automatic starter which accomplishes current limit acceleration in a way is the one shown in Fig. 5. A small series wound relay, set to raise its plunger at about 130 per cent. of the rated full load current of the motor, is connected in the armature circuit during acceleration. The lower end of the plunger is equipped with a copper disc which bridges across two studs that are connected in parallel

with a small coil of resistance. This resistance is in the circuit of the shunt wound solenoid which operates a plunger to close the resistance cut-out switches. A dash pot is used to keep this second plunger from being pulled up too rapidly. Now when power is applied to accelerate the motor the main plunger is pulled up through the action of the shunt wound solenoid and this closes the resistance cut-out switches in a predetermined sequence. But should the current input to the motor increase above 130 per cent. of the full load rating the series wound relay would raise its plunger and cause the coil resistance to be inserted in series with the shunt solenoid. This decreases the magnetic pull produced by the shunt solenoid to such a value that its plunger will not be raised any further until the motor current decreases sufficiently for the series relay to drop its plunger and cut out the resistance in series with the shunt coil. When the motor has attained its full speed and the accelerating resistance has been entirely short circuited, a curved copper brush makes contact with a pair of heavy lugs and forms a jumper around all the wires and leads of the starter, which are in the main motor circuit. Through the jig-dance action of the series relay during the acceleration of a heavy load, a sort of current limit acceleration is obtained, although it is not true current limit acceleration.

(*Concluded in the May number of* THE WORLD'S ADVANCE)

THE ROYAL ACADEMY

WHENEVER we see the words "Royal Academy" we naturally think of London. But there are four royal academies besides the British.

The Royal Academy of Arts was founded in 1768 by George III for the encouragement of painting, sculpture and designing; and Sir Joshua Reynolds, an American, was the first president.

The Royal Academy of Sciences at Copenhagen was founded by the King of Denmark in 1743. Then there is The Royal Academy of Sciences at Berlin founded by Frederick I in 1700. It is devoted to research in mathematics, physics, philosophy and history. And again there is The Royal Academy of Sciences at Stockholm founded in 1739 and now known as The Royal Swedish Academy. And still again there is The Royal Spanish Academy founded at Madrid in 1714. Its membership is limited to 24. The Imperial Academy of Sciences was founded at St. Petersburg in 1725 by Catherine I.

The French Academy was founded at Paris in 1635 by Cardinal Richelieu for the purpose of refining the French language and style. The Academy of Inscriptions and Belles Lettres (1663) and The Academy of Sciences (1666)—both founded at Paris by Colbert—and The Academy of Moral and Political Science (Paris, 1795), were merged with The French Academy and called The National Institute of France. Its membership is limited to forty, and these are known as "the forty immortals."

The others are: The Academy of Fine Arts at Paris founded in 1648, The Academy of Medicine at Paris, which is the national board of health, and The Academy of France at Rome.

In America we have The National Academy of Design founded in New York City in 1826; and The Academy of National Sciences of Philadelphia, founded in 1812. The latter has the best natural history collection in the country. There is also The American Academy of Political and Social Science founded at Philadelphia in 1889, as well as The National Academy of Sciences founded at Washington in 1863 with a membership limited to 100; and the American Academy of Sciences and Arts founded in Boston in 1780.

(*Continued on page* 550)

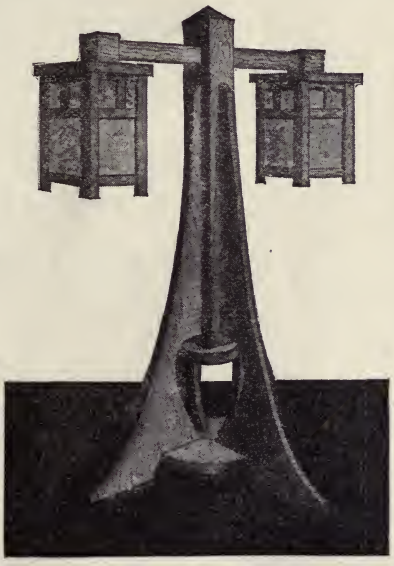
For the Handy Man

Edited by Thomas Stanley Curtis

A Table Lamp in Wood and Artglass

TO READERS who have followed the present articles, the design offered this month will appear exceedingly simple of construction, and so it is, for the difficult angles and complex features which, in other designs, may have made the builder wish he had four hands instead of but two, are conspicuous by their absence. The lamp presented herewith is, however, a project worthy of consideration both from the standpoint of appearance and general utility.

Following the custom established in previous articles, the complete bill of materials is given below and the wood should be ordered from the mill cut to size and sandpapered:



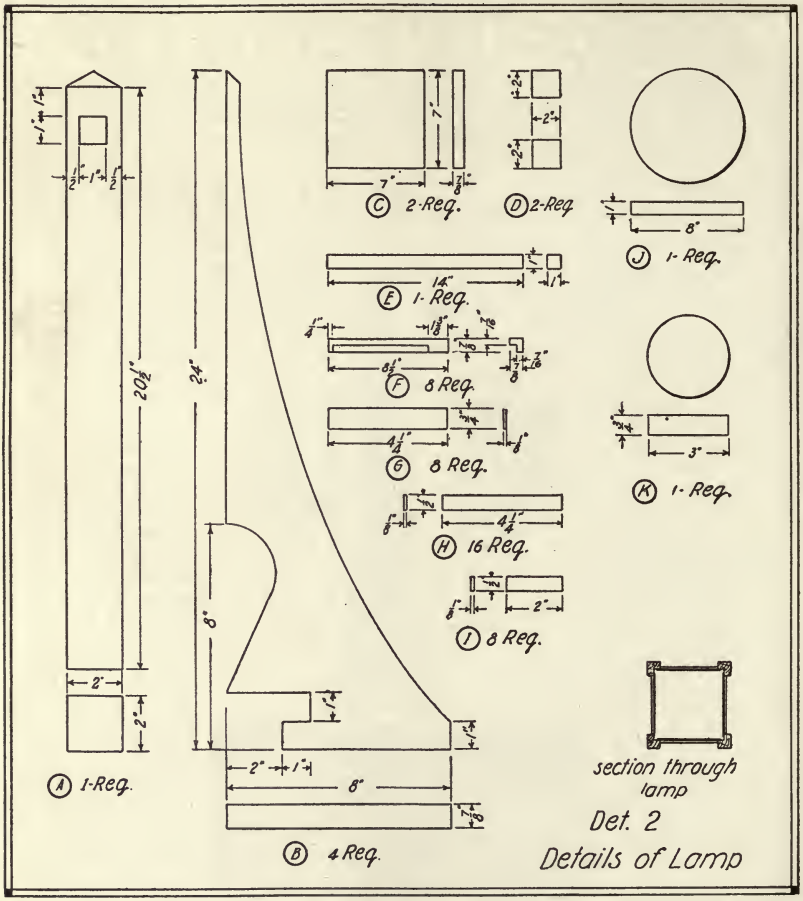
The Table Lamp Complete.

(*A*) 1-piece, 2x2x21 inch oak.
(*B*) 4-pieces, ⅞x8x24 inch oak.
(*C*) 2-pieces, ⅞x7x7 inch oak.
(*D*) 2-pieces, 2x2x2 inch oak.
(*E*) 1-piece, 1x1x14 inch oak.
(*F*) 8-pieces, ⅞x⅞x8½ inch oak.
(*G*) 8 pieces, ⅛x¾x4¼ inch oak.
(*H*) 16-pieces, ⅛x½x4¼ inch oak.
(*I*) 8-pieces, ⅛x½x2 inch oak.
(*J*) One disc, 1-inch thick by 8-inch diameter oak.
(*K*) One disc, ¾-inch thick by 3-inch diameter oak.

In addition to these, there will be required eight pieces of art glass of the desired shade to fit the sides of the lamps and two lamp receptacles to be screwed to the inside of the top of each lamp.

The construction of the lamp requires but little comment. The square hole is cut through the top of the main post *A* to pass the cross bar *E* which carries at its extremities the lamps proper. The parts of the latter are assembled in the manner shown with glue and brads. The latter should be well set and the holes filled with a paste wood filler mixed with the stain to be used on the framework of the lamp. The decorative slats *G*, *H* and *I*, are let into the corner posts and glued before the glasses are inserted.

The conductor from the electric lamps may be passed through the cross arm and down through the center post if the workman is ingenious. The trick may be done by drilling entirely through the cross bar and also through the center post with a fairly good sized bit. The flexible lampcord is then passed through the cross bar from end to end and a long steel wire with a hook bent in its

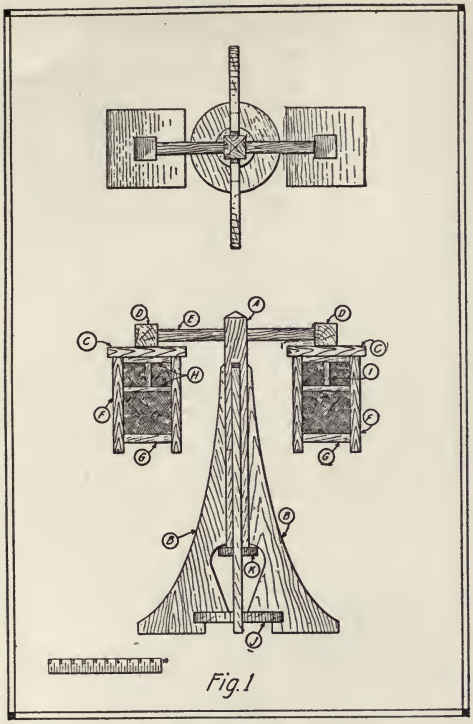


Details of Lamp Parts Showing Dimensions.

end is sent up through the center post and hooked over the cord. With the exercise of a little care and patience the cord may be drawn down through the post without injury to the insulation. The exit through the disc at the bottom of the post is a natural and graceful one and appearance of the wire is entirely inoffensive as it is led away to the wall or floor pocket.

No dimensions are given on the finished drawings of the completed lamp, but a scale is appended in order that the reader may readily take the dimension of any portion by cutting the scale from the page and using it on the drawing. In the detailed drawings, however, the reader will find each part accurately dimensioned.

The woodwork may be stained to harmonize with the decorations of the room in which the lamp is to be used.



Elevation and Plan Views of Completed Lamp.

AN UPSTAIRS SHOPPING DISTRICT

Do your shopping upstairs. That is the modern idea which has been developed in Los Angeles, Cal., where a nine-story office building is devoted almost entirely to retail stores.

The Title Guarantee Building in the heart of the shopping center was built especially for this kind of business and, although it was a decided innovation, three-quarters of the space was leased before the structure was completed. The ground floor is devoted to conventional business establishments; the mezzanine is given over to the Title Guarantee Company, and eight floors above are built with wide corridors lined on either side with plate glass store fronts that display goods quite as effectively as those on the street. One noteworthy feature is that no artificial light is required during the business hours.

Oddly enough, no attempt is made to keep the rival firms out of the proximity of their competitors. Indeed, the tendency is for certain floors to become centers for certain lines of business: thus the jewelers are on the fourth floor, the tailors on the fifth, the piano dealers on the seventh.

Altogether there are ninety-nine stores in this upstairs shopping section, and on the ninth floor there is additional area used as workshops for tailors, etc., so that the valuable display space can be put to best use.

The number of visitors to the building has been checked up during the year that it has been in operation, and an average of 10,000 a day is computed. The exclusive character of the business conducted there makes it especially restful after the crush of a bargain counter in the department stores, and that feature alone draws much valuable patronage.

Electric signs on the building invite attention to the novel features within, and the merchants get together and run their newspaper advertisements in a space together, thus making a better display for all. The idea will doubtless be widely copied, as it has proven highly successful.

ELECTRIC GATE OPENER

In England a gate opener, electrically-controlled from a distance, has been placed upon the market. The actuating mechanism for the gate is a spring motor which furnishes the power actually used to open the gate. The electric current, sent from a considerable distance perhaps, is used merely to release a catch which permits the gate to open under the impulse of the spring.

Electricity in Stagecraft

Edited by Thomas Stanley Curtis

Experiments with the Low Voltage Transformer

IN THE last article appeared a description of the apparatus necessary to produce a current of very low voltage but of great volume. Such a current may be applied to the requirements of the popular science entertainer in a number of ways and the space available in this department will permit of but a brief outline of the many interesting experiments it is possible to produce.

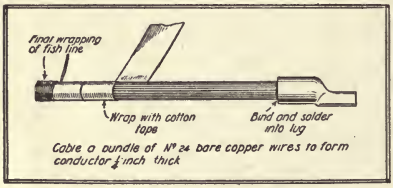


Fig. 11.—Showing Method of Insulating Cable.

As a necessary adjunct to the transformer described last month may be mentioned a pair of heavy cables to conduct the current from the secondary of the transformer to the appliances with which the experiments are to be performed. Such cable may be purchased in an electrical supply store, but it is likely to be rather too stiff for the requirements of the performer. For this reason the author suggests that the worker make his own cable, and the appended illustration (Fig. 11) shows how this may be done. A coil of No. 24 bare copper wire is cut into sufficient ten-foot lengths to make up two bundles of wire each ¼ inch in diameter when the wires are tightly bound together. The end of one bundle of wires is forced into a substantial lug and very carefully soldered to insure that a perfect electrical connection is made. This lug is then gripped in a vise and the wires are stretched individually and collectively along the bench with the ends held securely when the stretching has been done. A wrapping of cotton tape is then wound throughout the entire length of the cable starting at the end with the lug and finishing temporarily three or four inches from the other end where the tape is

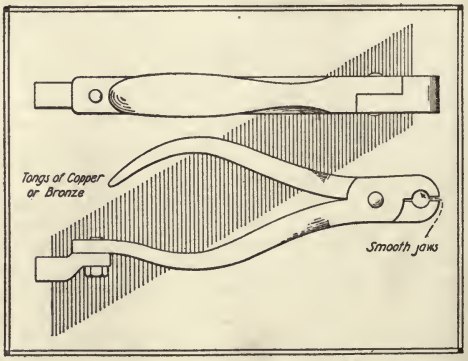


Fig. 12.—Elevation and Plan Views of Special Bronze or Copper Tongs.

bound with wire to keep it from unwinding. Again starting at the lug end, a layer of fine, hard fish line is wound around the cable and over the tape, finishing the covering of the cable. Before cutting tape and line at the finishing end the wires are to be cut off squarely and inserted into a second lug which is carefully soldered as in the case of the first one. The tape and line may then be brought up to the lug and finished off. The same process is repeated with the second bundle of wires to form a cable similar to the first.

The only other adjuncts necessary for the simpler experiments with the transformer are two pairs of tongs or clamps to which the cables are fastened. In Fig. 12 the reader will note a suggestion for a pair of tongs of suitable design, and if the worker is a fairly skilful pattern-maker he can make a pattern from which a copper or bronze casting may be made. Failing in this, he may use a dismantled pair of iron tongs or gas pliers for the patterns, making such changes as may be necessary with the aid of a bit of hard wax. The illustration is just one-half the size of the finished tongs used in the author's outfit, and it will not be safe to use a lighter weight of copper as the tongs heat up pretty well after the current has been on a few minutes. The lug of the cable is fitted to the handle of the tong, as shown in the illustration.

Assuming that the transformer has been set up, the worker will be anxious to try it out. The tongs may be grasped with the bare hands as the voltage of the secondary is so low that practically no shock will be perceptible; however, if the performer's hands are tender or susceptible to perspiration, the handles of the tongs may be dipped in white lacquer which will be quite invisible when dry but which, at the same time, acts as an effective insulator. The tongs having been connected to the transformer secondary by means of the cables, and the 60-cycle alternating current circuit through a 30-ampere fused switch, the performer may grasp a piece of ¼-inch steel rod about two feet long in the jaws of the tongs and have an assistant turn on the primary current. The steel will quickly discolor and become gradually red and then white hot. At this stage the current should be turned off and the performer should place a pair of gloves on his hands, explaining to the audience that, as they have just seen, the current passing through his hands has no effect whatever upon him, but that the intense heat so near his hands is worse than unpleasant. The heavy gauntlet gloves in place, the experiment can be carried to the stage of white heat, at which point the steel is almost plastic and the rod can be bent easily into a

(*Continued on page* 550)

"The Steel Will Quickly Discolor and Become Red and Then White Hot."

Electricity in Horticulture
Edited by Thomas Stanley Curtis

Plant Culture by High Frequency Current

Part II. Construction of the Condenser

IN the design of the condenser for our purpose, one or two primary requisites have constantly been borne in mind. The condenser is subjected to practically continuous use for several hours at a time and it is obviously essential that ample radiation surface be provided in order that the plates may remain cool. Coupled with this highly important point may be mentioned the importance of eliminating all corona or brush leakage around the edges of the tinfoil plates. These requirements are ordinarily met with in an oil immersed condenser, but the latter, to be efficient, should employ only oil as its dielectric and such a condenser presents constructional difficulties not easily conquered by the amateur workman. As the next best solution of the problem, the design for a glass plate condenser of large heat-radiating surface and of substantial construction is offered in this article.

For its construction the condenser will require 120 plates of glass 8 by 10 inches of the kind used for photographic negatives. Old plates of the latter sort may be purchased cheaply from nearly any photographer and they serve the purpose admirably. The first step is to remove the emulsion coating on each plate by soaking it in hot water and scraping with a putty knife. The plates are then to be dried thoroughly and divided into four piles of 30 plates each. The complete condenser consists of four units, of 30 plates each, connected in series mul-

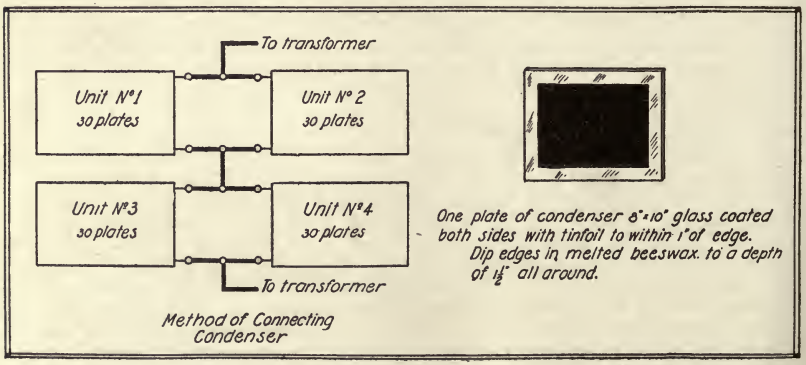


Fig. 1.—Showing Method of Connecting the Four Units of the Condenser and Also One Plate of Condenser With Tinfoil in Place.

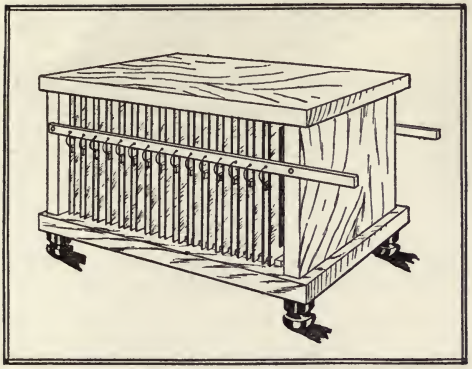


Fig. 2.—Perspective View of One Unit of the Completed Condenser.

tiple as shown in Fig. 1, and in order to make the description clearer the steps in the construction will be given for but one of the four units, which are alike in every particular.

A good grade of varnish gold size is procured and placed on the worktable with a good soft brush about an inch in width. Tinfoil of the grade used by florists may be procured in pound packages containing four or five strips of foil six inches wide and perhaps 48 inches long. The foil is to be cut up into pieces 6 by 8 inches in size, neatly flattened and separated ready to be applied to the glass plates, which should be arranged in a pile on the table. A plate is removed from the pile and given a quick, thin coating of the varnish (which dries in twenty minutes in the open air) and a sheet of foil immediately laid upon it, care being taken to see that the foil is accurately centered on the plate. The foil may be forced into smooth and close contact with the glass with the aid of a wad of cotton placed within a piece of soft cloth to make a sort of pounce or dauber. Starting at the center of the foil sheet and carrying the rubbing process toward the edges with a circular motion, the workman will be able to force the foil into what is practically absolute contact with the glass, and at the same time cause the surplus of varnish to exude from the edges.

The plate is then turned and coated on the other side in exactly the same manner; the process is repeated with each of the thirty plates in each of the four units until the 120 plates have been coated. The lot may then be laid aside to dry in a warm room for several days. When this has been accomplished, each plate is to have its edges dipped into melted beeswax to a depth of 1½ inches in order that the edge of the tinfoil on both sides may be thoroughly coated with the wax. This will quite prevent the corona or brush losses so frequently noted with glass plate condensers.

The rack in which the plates are to be mounted may next claim our attention. Its construction may be noted in Fig. 2, which gives a perspective view of the complete unit. The reader will see that the support comprises a baseboard and cover of wood separated by two end pieces. The plates slide in grooves formed by ½-inch square strips of wood nailed to the base and cover. A bar of ⅛ inch by 1 inch copper runs across from one end piece to the other on either side and affords a means of connecting the many plates in multiple. This connection is accomplished by means of the special contact leads shown in Fig. 3. These leads are merely pieces of lamp cord tipped at one end with a lug and at the other with a contact made from a piece of spring brass ribbon bent into the shape shown in the drawing. The object of the contact is to establish con-

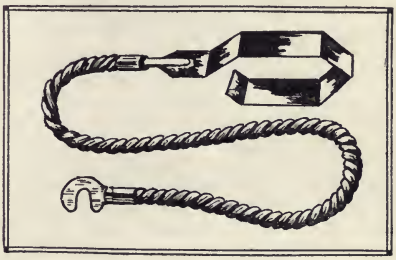


Fig. 3.—The Special Connector With Its Contact and Lug.

nection between both plates of tinfoil when the spring is inserted.

In making the connections to the bars on either side, the contacts are alternated in order that the plates may all be in multiple. That is, referring to Fig. 2, in starting to insert the contacts, on the one side the first contact spring is inserted between the first and second plate; on the other side the contact would be between the second and third; returning to the nearer side, the second contact is inserted between the third and fourth plates, and so on until all have been put in place. The contact with the first and last coatings are of course made by inserting the clip between the tinfoil and the wooden end piece, placing a small sheet of glass between the spring and the wood to prevent the metal coming into contact with the wood.

When the four units have been made as described, they are to be connected up as shown in Fig. 1, the connecting leads being strips of copper ribbon. The setting up will receive due attention, however, in a later article, when the rest of the apparatus has been described.

EXPERIMENTS WITH THE LOW VOLTAGE TRANSFORMER

(*Continued from page* 547)

U shape. A few minutes more and the steel actually burns up in the performer's hands, sending forth a shower of sparks in all directions. In order to protect the eyes and clothing from the sparks, it is well to wear a helmet and a large leather apron to completely cover the person. This dress has its psychological effect upon the audience also.

The transformer may be used to weld together two pieces of iron rod held in tongs and brought together; spot welding of sheet iron may be done if a device is built to provide sufficient pressure at the contacts; a mass of metal may be brought almost to the melting point if placed in a crucible and the terminals inserted; and, in fact, countless other experiments, many of which will suggest themselves to the possessor of the transformer, may be performed.

A most effective stage setting is one of dark purple velvet in the form of a cave-like affair. Practically all of the electrical experiments should be performed in semi-darkness in order that the effect may be striking. The fusing of copper and zinc rods held in the tongs with the stage dark makes one of the most startling experiments the author has ever beheld.

THE ROYAL ACADEMY

(*Continued from page* 542)

But why the word academy? The academy was a gymnasium in the suburbs of Athens in which Socrates and Plato taught the Greek youth who flocked to them. Socrates' discourses were of a moral nature. Hence, learned men when investigating, generally form themselves into an association and call the association an "academy."

MOTOR ROLLER SKATING THE NEW SPORT

Not long since a young New Yorker startled the natives by whizzing down a broad avenue on a pair of roller skates which appeared to be imbued with some supernatural power that made it unnecessary for the skater to move a muscle of his body. The mystery was solved when the observer noticed a tiny electric motor mounted on the rear of each skate and connected with one of the rollers by means of a small chain drive.

The storage battery furnishing the electric current for the motors was carried in a belt around the skater's waist and seemingly the weight was so slight as to be of no consequence.

Practical Electro Therapy

Edited by Thomas Stanley Curtis

High Frequency Apparatus*

IN DESCRIBING the internal construction of the high frequency coil it is thought best to divide the subject up under the several headings indicated by the various pieces of apparatus, within the case. To this end, therefore, the reader's attention is first called to

THE TRANSFORMER

The alternating current taken from the house lighting circuit at perhaps 110 volts is passed through a suitable controlling switch to the primary of the transformer. The function of this device is to change the intensity or voltage of the current from that suitable for lighting lamps to one many hundred times higher. The principle of the transformer has already been discussed in these columns, but for the benefit of the lay reader it may be said to be briefly as follows: When an alternating current is made to flow through a wire, a similar current will be produced in a second wire placed beside the first but having no connection with it. If the two wires be wound into coils and the coils placed side by side, the effect is greatly enhanced, and if a mass of laminated iron be placed within the openings in the coils the effect shows a very marked increase. This property of the alternating current is known as "induction" and the current produced in the second wire is said to be induced by that in the first. The voltage of the current induced in the second wire is in direct proportion to the ratio between the number of turns of wire in the first and second coils. Therefore, if the first coil contains one hundred turns and the second coil one thousand turns, the voltage induced in the second coil will be ten times that applied to the first. Accordingly, let us assume that in our transformer there are five hundred turns of wire in the first coil or *primary*, as it is called, and thirty-five hundred turns in the second coil or *secondary*. If we impress a voltage of 110 on the primary we shall have a voltage of thirty-five times 110 or 3850 volts at the secondary terminals.

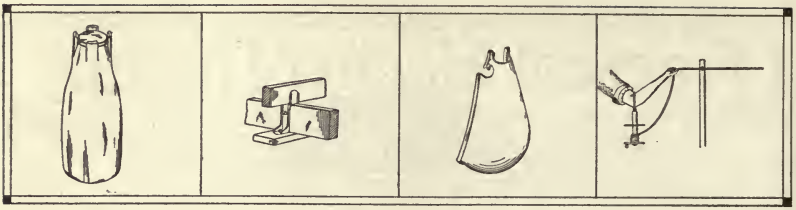
This high voltage makes it necessary to employ highly specialized methods of insulating the windings of the transformer for the tendency of the very high potential current is to leap through the air for a fraction of an inch or to tear its way through even the best of insulators unless they present sufficient resistance to its pressure.

In the next article we shall see how this high voltage is applied to the operation of the apparatus and what measures are taken to safeguard the patient from the dangerous current.

*This article is the second of a series on high frequency apparatus. The first article appearing in the March issue of MODERN MECHANICS is a general description of a portable high frequency outfit which is described in detail in this and succeeding articles.

THREE DEVILFISH TRANSPORTED FROM HAWAIIAN ISLANDS

Three giant octopi, or Pacific devilfish, have been safely transported from Hawaii to San Francisco, where they will be on exhibit among other strange and unusual types of sea life in the Hawaiian building at the Panama-Pacific International Exposition. These sea-terrors will be carefully confined in a large tank of sea-water.



Recent Novel Patents

An Odd-Shaped Bottle

A bottle of odd design is the subject of a patent granted to an Indiana inventor. As shown in the accompanying illustration, the upper portion of the bottle is fitted with four spring members that serve to hold a stopper in the form of a cap firmly in place. It is obvious that a bottle of this kind can be readily and effectively sealed, while its opening is also a simple matter.

Clamping Device

A metal clamping device, shown in one of the sketches, is the subject of a patent secured by a Western inventor. It consists of a piece of metal made in such a form as to permit it to hold in place two pieces of wood crossing each other at right angles, and is provided with a base by which it may be screwed on another piece of wood. This clamping device should undoubtedly prove of great value in certain lines of carpentry work.

A Sanitary Breathing Shield

A member of the United States Navy is the inventor of a novel sanitary breathing shield which is illustrated in one of the accompanying illustrations. The shield consists of a framework that serves to hold the resilient material forming the shield proper. Nose clips are provided so that the shield may be readily worn without the necessity of straps or other inconvenient holding members.

Clothes-Line Reel

A clothes-line reel, comprising a rotatable spool, a shaft on which the former revolves, and an arm ring, is the invention of a Wisconsin man. The accompanying sketch illustrates the device and shows how it is actually used.

Drawing Board Support

A convenient drawing board support has been patented by a Chicago inventor and is illustrated in one of the accompanying sketches. It is so designed that it may be fastened to any table. Suitable hooks hold the bottom of the drawing board, which rests against the rear support. The angle at which the drawing board is held may be altered at will. The device is made to fold up completely so that it may be easily carried about.

A Cuspidor Lifter

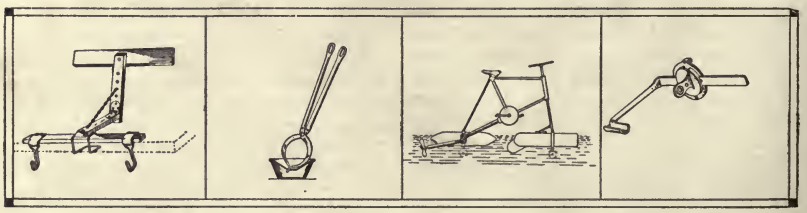
A Kansas inventor has recently been granted patent rights on a cuspidor lifter. This implement consists of two pivoted handles terminating at their lower ends in bowed jaws. According to the claims of the inventor, the jaws are inserted in the hole of a cuspidor and the latter can then be carried about and cleaned without the necessity of actually handling it as is now customary.

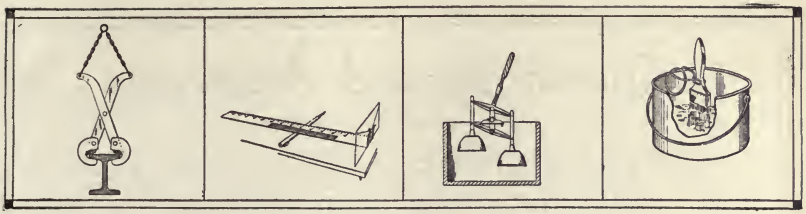
A Bicycle Boat

While numerous bicycle boats have been patented in the past, the one just patented by a Philadelphia inventor has several interesting features. His craft has the usual bicycle frame. In the rear it is fitted with two floats between which is placed a propeller driven by a shaft drive from the pedals. In the front, directly below and operated by the handle bars, is another float that is utilized to steer the water vehicle.

Improved Window Shade Bracket

A Pennsylvania inventor has just patented a combined window shade bracket and curtain pole holder that presents considerable ingenuity. As shown in the sketch, a part of the device is made to screw on the framework of a window and does not differ essentially from the usual window shade bracket. To this part of the device is fitted an arm that terminates at one end in a holder for curtain rods, the other end being bent and held in the shade holder base so as to slide either way to accommodate curtain poles of different lengths.





A Safety Beam Grip

A safety beam grip is the subject of a patent recently secured by a New York inventor. As shown in the accompanying sketch, his invention consists of a beam grip comprising two main pivoted members and two pivoted jaw pieces. The device is so designed that when the lifting power is exerted on the chain the jaws firmly grip the beam and cannot become loosened accidentally.

A Postal Scale Ruler

A Wisconsin inventor certainly deserves much credit for his exceedingly clever invention which is in the form of a combined ruler and postal scale. As shown in the sketch, his device resembles a conventional ruler with the usual markings on one edge, while on the other edge are special markings relating to the weight of mail matter in ounces. At one end of the ruler is provided an upright piece for holding a letter or other mail matter in place while it is being weighed. A round pencil is slipped under the ruler to act as the fulcrum and the ruler is then shifted along the pencil until it balances. The markings nearest to the pencil indicate the weight of the mail matter held on the end of the ruler.

A Washing Machine

A compact, hand-operated washing machine is the subject of the patent granted to a New Yorker. His machine consists essentially of a container for holding the clothes to be washed and the water, a system of levers actuated by hand power, and two bowl-shaped members that alternately plunge into the container. The lever action is so designed that the plungers work in a vertical axis. Clothes are washed in this machine by pushing the handle back and forth for a certain period of time.

Paint-Brush Holder

Nothing is more annoying than to have the handle of a paint-brush become covered with paint or varnish, caused by its slipping into the liquid or rubbing against the sides of the can or other container. To eliminate this trouble an inventor hailing from Colorado has devised a simple holder of bent wire that may be attached to any can and will hold the brush in the center of same.

Attachment for Handsaws

A Canadian inventor has recently secured patent rights on a simple attachment for handsaws that serves the purpose of blowing away sawdust as fast as it is formed while sawing through a piece of wood. Not only does this lighten the task of sawing, but it also enables the workman to see the saw cut and accordingly makes for accurate work. The device is simply a rubber bulb, fitted into the handle of the saw and equipped with a spout that points downward towards the work.

An Improved Spike

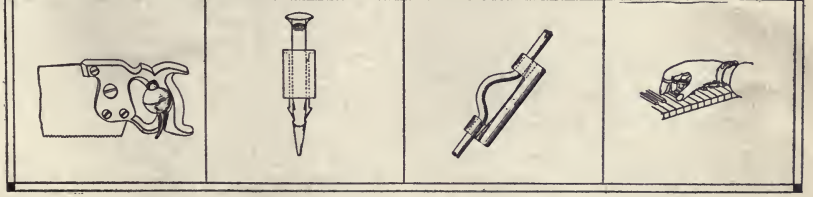
Much ingenuity is displayed in a recently patented form of spike invented by a Tennessee native. As shown in the accompanying sketch, his form of spike consists of a principal member with a barbed point, and a sliding member containing a split sleeve. The action of the spike is quite obvious if the drawing is studied. As the point is driven into a piece of wood the action is quite conventional until the spike has been driven in as far as the sliding member, successive blows causing the sliding member to move upward and the sleeve to spread out and become firmly anchored in place by means of the barbs.

Lamp Cord Adjuster

Nothing could be very much simpler than the cord adjuster recently patented by a Pennsylvania inventor and illustrated in one of the accompanying sketches. The cord adjuster consists of a piece of insulating material of the shape illustrated, as well as a spring that presses at both its ends against the lamp cord passing through the device. The cord adjuster is so designed that it can be slipped on any lamp cord without the necessity of taking off the socket or disturbing the connections in any way.

Finger Trainer for Pianists

A New York inventor has devised a novel arrangement to be worn by persons learning piano playing. The invention consists of an adjustable wrist band to which are connected by means of straps several loops that are placed around the fingers of the hand. The arrangement serves to hold the wrist and fingers in the proper position and thus trains the learner to hold his or her hand correctly.



Questions and Answers

This department will appear regularly in THE WORLD'S ADVANCE, subject to following regulations: The questions must be legibly written with typewriter or in ink, on one side of the sheet. Each question must be definite and cover but one point of the subject under consideration, although a letter can contain more than one question. On the 10th of the second month preceding the date of issue of the magazine, all the questions on hand will be considered and those which are put in the most intelligent manner and of widest general interest will be selected for publication in such issue, the number being governed by the space available. All other questions will be returned to the writers with a statement of the price for which they will be answered by letter. Return postage must be enclosed with each letter containing questions, and the letters must be addressed to the Questions and Answers Department and contain nothing relative to other departments of the magazine.

In reply to the many requests of our readers as to where they may obtain call books with both the United States and foreign calls, we will say that there is not published in this country a complete call book the same as the one for United States stations only. All United States calls, including those of amateur stations, are published in a call book which may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for fifteen cents. The complete list of international calls may be obtained only from the International Telegraphic Union at Berne, Switzerland. The Marconi Yearbook, however, contains a reasonably complete list of international calls, and in addition a map showing the principal wireless stations of the world. This book may be obtained from our Book Department

PRIMARY CELLS.

(29) H. Frankland, New York City, asks:

Q. 1.—What is the amperage of the average wet cell and of the average dry cell?

A. 1.—The amperage which it is possible to get from a cell will depend on the resistance of the measuring device used. If an ammeter of low resistance is used the ordinary wet cell, such as is employed for bell work, will give about 5 amperes on a short circuit. Dry cells vary from 25 to 35 amperes; small flashlight cells from 5 to 10 amperes. The type S Edison caustic of soda cell will give from 30 to 35 amperes. None of these cells will stand this rate of discharge for any appreciable length of time.

Q. 2.—Is a battery of Grenet (bichromate) wet cells suitable for operating a wireless spark coil?

A. 2.—Yes.

Q. 3.—Does a multiple connection of cells increase the voltage?

A. 3.—A battery made up of cells connected in multiple would have the same voltage as a single cell, but its internal resistance would be less, and accordingly the output would be greater. A cell has a definite voltage regardless of its size. Its internal resistance, however, decreases with increase in size. The capacity in ampere-hours increases with increase in size, so that while the voltage remains the same for all sizes of the cell, the output in watt-hours will increase as the size is increased.

RADIO SET.

(23) C. M. Patch, Dubuque, Ia., writes:

Q. 1.—I am working on a one kilowatt set with an end in view of having it theoretically as well as actually correct in every detail. There are several questions of more or less technical nature pertaining to the glass plate condensers that I am working on which I desire to get advice on. Good advice is hard to get and with the knowledge and experience you have, I am sure you are in a position to help me out better than anyone else. The capacity of a transmitting condenser, designed to balance up well with the inductance of an oscillation transformer to tune to a 200 meter wave, as I understand, is determined by dividing 1,000 × the power in Kw. by the number of cycles per second × the secondary voltage, squared. In my case I have one of Clapp-Eastham's 1 Kw. type E (12,000 volt secondary) transformers to use on 110 volt, 60 cycle supply. This figures 0.00000001157 Farads. Multiplying by 1,000,000 changes it to 0.01157 M.F.

My idea is to build four units of 0.01157 M. F. capacity with a little additional capacity which I may use or not, just as is necessary. Then I will connect these four units in series multiple so as to avoid too much strain on the plates. Will ⅛-inch glass be necessary or will 1/16-inch be sufficient?

A. 1.—The 1/16 should be sufficient.

Q. 2.—Clapp-Eastham state that 12 plates coated with 6 by 8 inch pieces of tinfoil should give sufficient capacity for each unit.

Do you think that this statement is correct?

A. 2.—Yes, this will give sufficient capacity.

Q. 3.—How can I fasten the tinfoil on and what should the condenser be immersed in?

A. 3.—The condenser may be immersed in transformer oil. An excellent way to fasten the tinfoil on is as follows:

Place the plates in a moderately warm oven and heat them for five minutes; remove them and rub the surface with beeswax. The tinfoil should have rounded corners, and just before it is spread over the surface of the glass, a piece of copper ribbon should be slipped underneath, making a lug for connections. Spread the tinfoil on the other side in the same manner, and when completed paint the edges with hot beeswax. Beeswax is far superior to shellac because it does not blister like shellac. It is the blistering which causes most of the failures in plates.

Q. 4.—Can I mount the condenser on one side of a panel switch-board and use switches mounted on the other to cut in additional amounts of condenser?

A. 4.—Such a method might be permissable if it were not necessary to reduce the length of leads to an absolute minimum. The 200 meter requirement makes it necessary to use very short leads, too short in fact to permit such a convenient method of connecting up condenser plates to be used.

FIELD AND ARMATURE DATA.

(24) H. H., Helena, Mont, asks:

Q. 1.—Can a certain laminated field and a short-circuited armature be utilized for making a practical motor, say for driving a small lathe, washing machine, etc.? Outside diameter of stator sheets is 7⅝", outside diameter of rotor is 3½", both being 2" thick. There are four field poles, and rotor has 17 one-quarter inch copper rods. Motor has been rated as 3-phase, ½ h. p.

A. 1.—Unless you have been seriously mistaken as to the construction of the stator, the motor could not have been operated on a three-phase circuit, there being no way to wind four poles for such a supply. It certainly appears as an ordinary single-phase fan motor, but far from ½ h. p., say 1-10 h. p. You will not find efficient "power" motors for alternating current circuits with the definite sort of poles used for direct current machinery. You should have numerous internal slots, say not less than 24, wound in the manner clearly described in Watson's articles.

COATING IRON WITH TIN.

(25) J. E. T., Plessisville, P. Q., asks:

Q. 1.—How can a cast iron vessel be coated with tin? He states that if he can succeed in doing such work he will take a fine position, and get plenty of work.

A. 1.—We are sure that if you could find out how to do this you would indeed get a fine position—you might readily expect a million dollars for the process, but no one as yet knows how to do it.

CHANGING MOTOR WINDING.

(26) E. B., North Attleboro, Mass., asks:

Q. 1.—How to adapt a 110-volt 125-140-cycle fan motor to a 60-cycle circuit?

A. 1.—Your motor has either eight or ten poles, but for the lower frequency circuit it should have only four poles. If your motor has eight poles, you can reconnect them so as to have two adjacent poles North, the next two South, and so on, giving a partial equivalent of half the present number. The operation of the motor, however, will be uneconomical.

INTERNATIONAL SIGNAL CODE.

(27) C. V. Williams, San Jose, Calif., asks:

Q. 1.—Kindly give list of all Official Abbreviations and the International Signal Code or where same can be purchased.

A. 1.—The International Signal Code is not a set of abbreviations intended to be sent by wireless, but instead is a flag code. There are flags to represent every letter in the alphabet and words may be spelled out by means of these flags. To make transmission more rapid there are sets of abbreviations used to designate common nautical expressions. The code may be found in many nautical books and you can doubtless obtain a copy from the Government Printing Office at Washington. There is also another set of signals known as distant signals. These are formed by hoisting cones, balls and drums. As the cone has two positions there are four characters available, each of which is designated by a number. Common expressions may be formed by these symbols according to the International Code.

Q. 2.—If this list is not of the International Signal Code then please state their meaning: 6, 73, 10, 21, 121.

A. 2.—As previously mentioned there are but four characters available so we do not believe that the numbers you heard were the equivalent of the distant signals sent by radio. Perhaps what you heard were abbreviations used by some particular line. "73," of course, is the common greeting expression. We have no interpretation of the others mentioned. If, however, the numbers were the equivalent of the distant signals the only two capable of interpretation are 21 and 121. The former means "immediate assistance wanted" and the latter "I am aground." Perhaps some of our readers may have further information as to what these signals were and we would appreciate it if they would send in their opinion in order that the subject may be more fully discussed.

RADIO SECTION

Devoted to the Encouragement of Amateurs and Experimenters in the Field of Radio Communication.

SOLVING THE AMATEUR'S DIFFICULTIES*

Helpful Information Tending to a Better Understanding of the Radio Law and Increased Efficiency of Apparatus.

By E. E. Bucher

Instructing Engineer, Marconi Wireless Telegraph Company of America.

IN the March issue of MODERN MECHANICS there appeared the first part of this article dealing with the solving of the amateur's difficulties. Continuing the discussion:

OSCILLATION TRANSFORMERS.

It is believed by many amateurs that in order to emit a pure wave to comply with the United States regulations, it is necessary to construct an elaborate inductively coupled oscillation transformer in place of the single coil helix generally used. There can be no denial of the fact that a transformer of the former type allows rapidity of adjustment unattainable by the plain "helix," but practically the same results may be produced with the latter.

Referring to the diagram in Fig. 3, let *AB* represent an ordinary direct coupled helix. Let us say, for example, it consists of 8 turns of wire spaced ½-inch, each turn 12 inches in diameter. If the capacity of the condenser *C* is of such value that in order to obtain a wavelength of 200 meters in the closed oscillatory circuit but ½ turn or less is required between points *E* and *D* for resonance, it is evident that the mutual inductance between the closed oscillatory circuit and the antenna circuit is of small value. Therefore, the emitted wave will approach a single frequency of as pure a character as may be expected from a "loose-coupled" oscillation transformer.

Take a similar case as shown in Fig. 4. The oscillations in the antenna circuit take the path through the helix from *A* to *B*, while those in the closed circuit take the path *D* and *E*. Since the active turns of either circuit are some distance from one another, the mutual inductance is correspondingly small and, if sufficient space intervenes be-

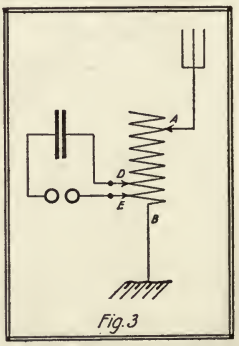


Fig. 3

Connections for an Ordinary Direct-Coupled Helix.

*The first part of this article appeared in the March issue of MODERN MECHANICS. The subjects covered in that issue were: Aerials and the Law, Transmitting Condensers, and Rotary Gaps.

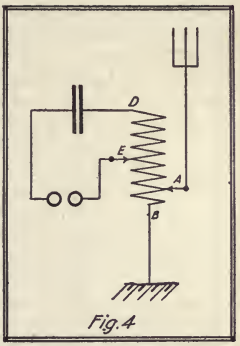
tween the active turns, a wave-length of single frequency is emitted from the antenna circuit.

It should be clear, then, that an inductively coupled oscillation transformer is not required to comply with the United States laws, and that a single coil may be employed if used in the manner shown in the preceding paragraph.

RECEIVING TUNERS.

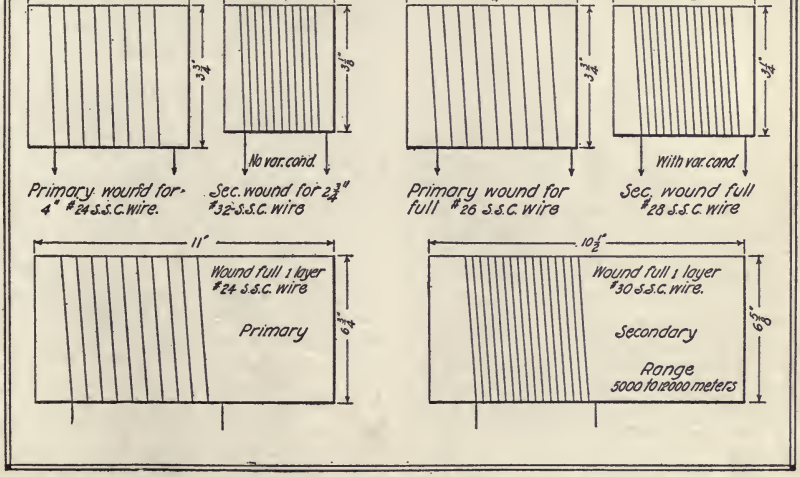
Many amateurs are in doubt concerning the proper dimensions of a receiving tuner for their work. Some attempt to build a receiving tuner having an enormously wide range of wave-lengths, making no provision for the elimination of dead-ends. If the tuner is to be used for wave-lengths up to 600 meters only, the windings can be very small indeed. For instance, a cardboard tube 3⅛ inches in diameter wound for a distance of 2¾ inches with No. 32 wire, gave a secondary winding of sufficient length to tune to wave-lengths of 600 meters. Now the size of the primary winding to correspond with this secondary winding for 600 meters cannot be definitely given, as the size of the aerial with which it is to be employed is not known.

If the progressive amateur desires to receive waves of greater length, an inductively coupled receiving tuner for tuning to wave-lengths of 3,000 meters may have the following approximate dimensions:



Another Scheme of Connections for a Helix.

The secondary winding should be 3½ inches in length and 3¼ inches in diameter, wound closely with No. 28 wire. If this winding is shunted by a condenser of 0.001 Mfds. capacity, the circuit is resonant to wave-lengths up to 3,000 meters. The primary winding for this same tuner may have a length of 4¼ inches and a diameter of 3¾ inches,



Winding Data for Primary and Secondary of Loose Couplers for a Large Range of Wave-lengths.

wound closely with No. 26 S. S. C. wire. With an antenna having a natural wave-length of about 350 meters, this winding will receive wave-lengths up to 3,000 meters. If the antenna has a natural period of 160 meters the primary winding must be proportionately increased or a loading coil added in series with the winding as described.

Amateurs who desire to receive the longer wave-lengths with a considerable degree of efficiency should erect two aerials, one of short wave-length for transmitting on the 200-meter wave and the other of greater length for the reception of signals from the high power stations.

A single wire aerial is quite sufficient for receiving, providing the wire has a fair degree of conductivity. Such an aerial for wave-lengths up to 10,000 meters should have a flat top length of at least 1,000 feet—preferably 2,000 feet—the height being decided upon by the amateur. Of course, a wire of this length is not suitable for the reception of 200-meter signals. For maximum results the short wave signals must be received on the smaller transmitting aerial.

A 200-meter aerial is fairly suitable for the reception of wave-lengths up to 3,000 meters, but for bringing in stations above this value it will be necessary to resort to a longer aerial.

Amateurs living in the open country are not required to erect an aerial especially for the reception of long wave-lengths, but instead they may use the telephone line connected to their own residence. The aerial binding-post of the receiving tuner may be connected to one side of the telephone line, the ground binding post being connected to a short wave condenser in series with the earth connection. If the series condenser is of small value—0.001 Mfds. or less—it will not interfere in any way whatsoever with conversation taking place on the telephone line, nor will the one tapping in on this line be able to hear telephonic communications. It has been found possible on an ordinary telephone line, to receive messages from high power stations at a distance of 3,000 miles. Fig. 5 illustrates the scheme of connections.

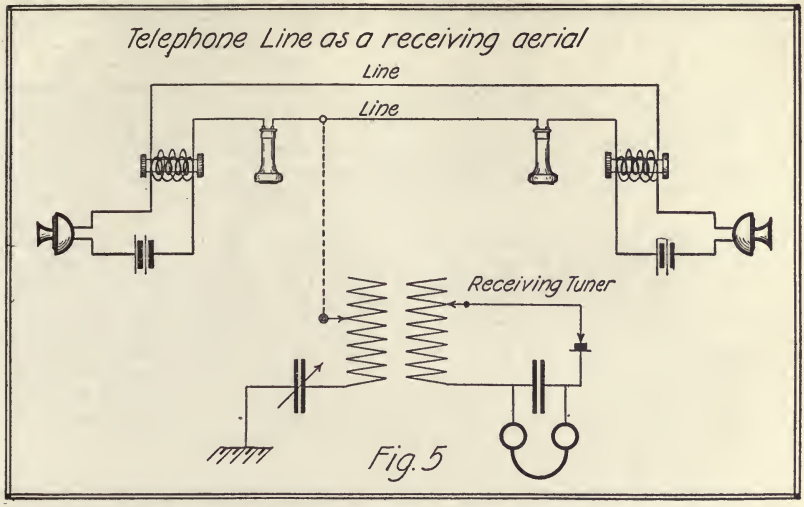
Many amateurs are interested in knowing the dimensions of a receiving tuner for very long wave-lengths and accordingly the following may be of value:

The secondary winding should be 10½ inches in length on a form 6⅝ inches in diameter, wound closely with one layer of No. 30 S. S. C. wire. When this winding is shunted by a condenser of 0.0003 Mfds. capacity it gives a wave-length value of 7,500 meters, and with a variable condenser of greater capacity it will quite readily afford adjustments to a wave-length of 10,000 or 11,000 meters. The primary of the same tuner may be 6¾ inches in diameter and 11 inches in length. It is wound closely with one layer of No. 22 or 24 S. S. C. wire. This receiving transformer should be used in connection with an aerial at least 1,000 feet in length and preferably longer.

In the dimensions of the receiving tuners as given so far, the size of wire for the secondary winding has been purposely selected for use with detectors of the crystal type. If the amateur intends to employ the audion as the receiving detector and desires to receive the maximum strength of signals with a minimum of losses due to distributed capacity, he should not hesitate to make the secondary windings of wire as small as No. 36. This affords a maximum potential which is necessary for increased strength of signals.

The audion is essentially a high resistance detector and therefore requires a considerable value of potential for the best results. If a condenser is used in shunt with the secondary winding, it should always be one of small value and its maximum capacity in no case should exceed 0.0001 Mfds.

In connection with receiving tuners, it is a fact worthy of consideration that the maximum strength of signals is obtained with practically all types of detectors when the inductance of the secondary winding predominates rather than the capacity; that is to say, when the capacity in shunt is of small value as compared to the value of the inductance for a given wave-length. On the other hand, better syntonic effects are secured



Connections for Employing a Telephone Line as a Receiving Aerial.

at the receiver when the value of the secondary inductance is small and the shunt capacity proportionately large, provided the coupling is correspondingly decreased.

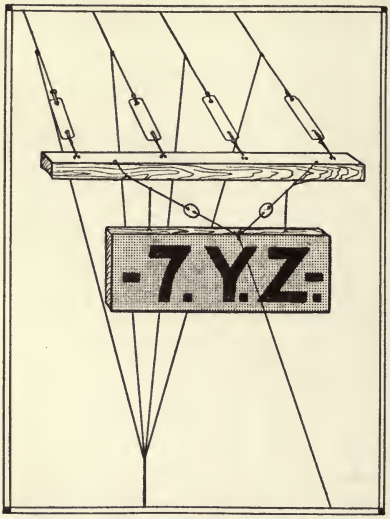
In an early issue of THE WORLD'S ADVANCE the writer will discuss testing buzzers and the testing of receiving transformers, bringing to light many new points that are not generally known.

WESTERN AMATEURS SEEK TO OPERATE THEIR INSTRUMENTS AGAIN

In the Sixth Radio District, which embraces California, Utah, Nevada, Arizona and Hawaii, the amateurs have been refused permission to either send or receive, ever since the war in Europe began. Rear-Admiral Pond of the Twelfth U. S. Naval Inspection Department, placed the ban on the wireless amateurs, much to their regret.

The Government's intention was to prevent a breach of the neutrality regulations, on the supposition that the amateurs might send information to foreign ships, California's coastline extending some seven hundred miles along the Pacific coast. The amateurs are certain they could be trusted to observe the rules of strict neutrality, and a movement has been started to induce Admiral Pond to raise the ban. The Sunset Radio Association of San Francisco, of which Walter Maynes, a licensed operator, is president, has taken the matter up and is circulating petitions throughout the entire Sixth District for the signatures of amateur operators, the intention being to present these petitions to Admiral Pond and induce him to lift the ban on amateur wireless.

The amateurs pledge themselves to a strict observance of the nation's neutrality, and hope to be placed on their honor in the matter of sending and receiving. All operators in this district are eagerly availing themselves of the opportunity to sign the petitions and thus boost the good work. These petitions may be secured by addressing either Walter Maynes, President, 207 Hugo street, San Francisco; Carroll Reed, Secretary, 1683 7th avenue, San Francisco; or Howard Lee, 1580 Grove street, San Francisco.



By Means of a Small Sign Hung On the Spreader of an Aerial, Passers-by are Informed of the Station's Call Letters.

A STATION NAME SIGN

Many times in his travels an amateur will happen to see an aerial and the question will immediately come to his mind: "Have I ever 'talked' with that fellow?" If the amateur had a means of telling who the aerial belonged to he would immediately know whether he had "talked" to its owner before.

In view of the foregoing, it would probably be a good plan for amateurs to place a sign made of either wood or metal and of about the same size as an automobile license plate on a spar of the aerial, as shown in the sketch. Not only will such a sign inform passersby as to the call of the station, but it will also prevent the aerial from turning over in a storm.—Frank H. Broome.

DEPRESSED ANTENNAE

It has been found that the antenna of a wireless apparatus, although fixed only a few inches above the ground, will successfully receive radiations from a considerable distance. In a garden at St. Denis, a few miles from the center of Paris, Professor Rothé placed on posts about six inches high a copper wire that was varied in length from 50 to 115 feet. The insulation was poor, and the wire touched the grass at several points. It was not laid in the direction of Paris. Professor Rothé used a water pipe for the earth connection, and also arranged a detector, a telephone and a battery in series between the water pipe and the common terminal of the aerial and the self-induction. With this arrangement he received distinct signals from the Eiffel Tower. He used first a 400-ohm telephone and then a 150-ohm receiver shunted across a Jégou transformer. Another French experimenter had equal success, and it is predicted that on account of their cheapness and simplicity, the depressed aerials will be extensively used.—Edwin Tarrisse.

MICA PLATE FOR ROTARY SPARK GAP

It is not necessary to use hard rubber or other expensive material for rotary spark gap discs. Sheet micanite 1/32 inch thick will be found excellent material for making rotary gap discs for powers up to ½ kw. The micanite plate should be reinforced by a heavy brass or copper ring such as is usually employed in rotary gaps. This ring prevents the mica from chipping at the edge. Micanite has one fault and that is due to its being made of mica and shellac—when it is heated the shellac melts. To avoid this trouble when employing it for a rotary gap, the transmitting key should not be pressed while the gap is standing still, since the studs would become heated and consequently cause a warping of the disc.—Irving Farwell.

A seaman who partook in the naval fight off the Falkland Islands between the British and German fleets, recently disclosed a few sidelights of that engagement. He states that before the fleets joined in battle, the British vessels endeavored to communicate by wireless with each other the various orders and instructions for the battle formation and succeeded despite the enemy's jamming.

AMATEUR WIRELESS STATIONS

THE STATIONS AND APPARATUS IN THE ABOVE VIEWS ARE AS FOLLOWS:

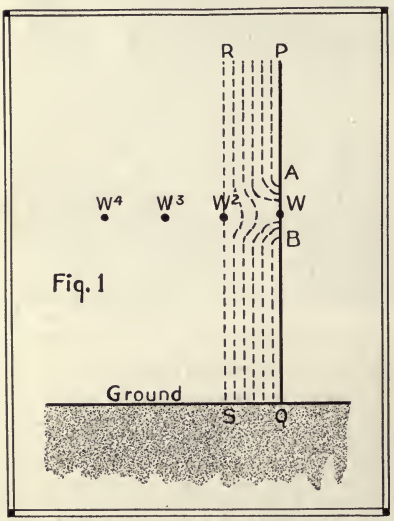
(1)—Receiving and Transmitting Apparatus of D. B. Tripp of New Bedford, Mass. Practically All of the Apparatus in This Station Has Been Made by Its Owner. (2)—Wireless Station of C. G. Howard of Newark, O. (3)—Receiving and Sending Apparatus of Peter Faber of Madison, Wis. (4)—Wireless Station of Fred F. Dennis, Fair Haven, N. J. The Receiving Apparatus Has a Range of 1,500 Miles, Day and Night. (5)—A Corner of the Experimental Laboratory of Guy A. Hunter, Port Townsend, Wash., Showing the Switches and Various Instruments. (6)—Wireless Station of James P. McQuaide, Larchmont, N. Y.

In Defence of the Flat Top Aerial

By Raymond W. Woodward, B.S.

IN the February number of MODERN MECHANICS there appeared an article entitled "The Fallacy of the Flat Top Aerial," in which it was stated that an aerial composed of wires placed one above the other would prove to be more satisfactory than the customary flat top antenna. It is the purpose of this article to show wherein the writer believes that the foregoing conclusions are erroneous and that other things being equal the flat top aerial is more suitable for wireless reception than the above mentioned type.

In the first place, if we glance at the various commercial aerials throughout the country, we will see that the majority of them are of flat top construction, and none have the wires in a vertical plane. Notable examples are practically every ship, the huge government station at Radio, Va., and the more recent high power Marconi installations. With the possible exception of the latter, it would have been mechanically simpler to have placed the wires one above the other. If such has not been done there must be ample reasons for it.



A Diagrammatic View of a Wireless Wave Cutting the Wires of a Flat Top Aerial.

If the wires were placed in a vertical plane, each would be at a different height above the earth and would therefore have a different capacity. Such an arrangement would be unsymmetrical and would probably not have a fundamental wave length of definite value, as would be shown by the wave meter condenser indicating resonance over a larger range of the scale than usual. Consequently, if the aerial were used for transmitting it would be difficult to comply with the federal regulations concerning dampening—if not impossible.

As stated in the article referred to, the electromagnetic waves travel parallel to the ground; the wave front, however, is at right angles to the ground. It is generally acknowledged that the propulgation of electromagnetic waves is analogous to that of light waves. Now, it is a fundamental fact in the wave theory of light that every point in an advancing wave front acts as a new point source of light, and the same holds good for electromagnetic waves. Thus, when a wave front strikes a flat top aerial we will have a condition similar to that represented in the accompanying sketch. Here W_1, W_2, W_3, etc., are cross sections of the wires, and PQ is the wave front just as it strikes W_1. Energy will be absorbed for a short distance on either side as AB. Regarding points on AP and BQ as new sources of wave emanations, as shown by the dotted lines, the two portions of the wave will again come together, and, if the wires are properly spaced, W_2, will be cut by a solid front wave having only slightly less total energy than at W_1. This process will repeat and all the wires will receive very nearly the same amount of energy. However, if the wires are

placed too close to each other, the second wire will be in the "shadow" of the first and removing all but one strand of the aerial will then show no appreciable diminution in the strength of received signals.

The reason that a single long wire appears to give the best reception is because most amateurs base their results on long distance work, and that stations capable of transmitting over long distances do so by the aid of long wave-lengths. Since an aerial absorbs the greatest amount of energy when working at or near its fundamental wave-length the long aerial will give the best results for this work. If other wires were added of the same length as this single one, still better results would be obtained.

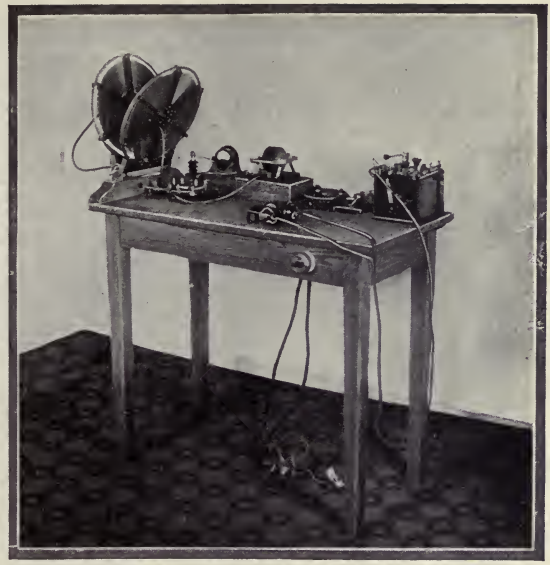
From the writer's own experience he has had the best results when the spreaders at each end of the antenna were horizontal, although at times they have accidentally become nearly vertical.

It should not be inferred from the above discussion that the flat top T or L aerial is the best type for all conditions, but it probably is for amateur use.

NEW RADIO SETS FOR COAST ARTILLERY AND HARBOR BOATS

In the accompanying illustration is shown one of the latest sets made by the United States Signal Corps and intended for use by the Coast Artillery division as well as on harbor boats.

The new sets consist of a quenched gap transmitting set and an exceedingly compact receiving outfit, both being mounted on a substantial table. The transmitter is equipped with a pan-cake type oscillation transformer that can be adjusted to secure the maximum efficiency and the sharpest tuning.



Sending and Receiving Apparatus for Coast Artillery and Harbor Boats.

A COMMENDABLE RECEIVING RECORD

The writer recently made a record which he believes worthy of notice on the part of fellow wireless amateurs. Lately, while moving his station from one location to another, the writer erected an aerial consisting of a single wire stretched from a point on a house twenty feet above the ground to a pole six feet high and fifty-four feet away, and back again to a point on the house fifteen feet above the ground. The free ends were connected together and brought to the receiving instruments comprising a standard loose coupler, a cat whisker silicon detector, rotary variable condenser, fixed condenser and a pair of receivers. On the evening of the 26th of September the writer was surprised to pick up signals from Key West (NAR) with the foregoing-described set and aerial. Since then, signals from that station have been heard three times. Any night signals can be received from NAA and WSL.

—Allen W. Coven.

IOWA RADIO RELAY LEAGUE

The Iowa Radio Relay League was organized during the month of February. Amateurs in several Iowa towns have been admitted to the League, the purpose of which is to have a station in every large town in the state, placing the amateurs in communication with each other and assisting them in developing their wireless apparatus.

At the election of officers on February 4th, the following appointments were made:

President, Chas. E. Lockwood; Vice-President, A. P. Leckington; Secretary, Kenneth Lamb; Treasurer, Francis Harbin.

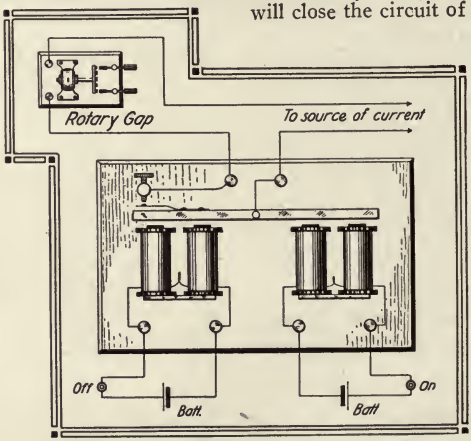
Amateurs in Iowa and neighboring states wishing to join the League should correspond with Chas. E. Lockwood, 117½ Bridge Street, Waterloo, Iowa.

Amateur radio clubs and associations throughout the country are invited to send copies of their proceedings and letters telling of the experiences of members to The Radio Section of THE WORLD'S ADVANCE. Such material, when it proves available for use, will be paid for at space rates on publication.

STARTING ROTARY GAP MOTORS BY PUSH BUTTON

In many stations employing rotary gaps it may be found more convenient to employ ordinary push buttons in preference to a snap switch to start and stop the motor of the gap. By following the directions and diagram given below, a system is secured whereby two push buttons do the work.

To begin with, secure a piece of square iron bar of suitable size and bore a hole through its center so as to pivot it at that point. The armature should be so mounted and adjusted that when it is pulled to either side it will remain in that position. The drawing explains itself. It will be noted that when the button labeled "on" is pushed, the armature is drawn and makes the contact that closes the motor circuit. When the push button labeled "off" is pressed the bar is pulled so as to break the motor circuit. If desired, the device may be elaborated on by using another contact that will close the circuit of a magnetic break such as was described in a recent issue of *Popular Electricity and Modern Mechanics*, when the motor circuit is opened.



A Simple System for Starting and Stopping a Rotary Gap by Means of Push Buttons.

In the event that any difficulty is experienced through arcing at the break of the contact, a small paper and tinfoil condenser may be shunted across the contact points; if this still proves ineffectual, the two pairs of magnets may be moved closer together on the baseboard in order to increase the separation of the contact points by increasing the travel of the pivoted arm.—WILLIAM H. HALLENBECK.

Surrounded by His Numerous Wireless Instruments Both in Finished Form and Process of Development, Mr. Eugene T. Turney is Quite at Home in His Laboratory.

An Interview with Eugene T. Turney.

By Thomas Stanley Curtis

A VISIT to his laboratory and a chat with Eugene T. Turney brought to light two interesting facts which in themselves constitute what may be termed a paradox. First and foremost, Mr. Turney is an inventor and one of no mean ability; coupled with this, he is a business man. Strange as this combination may seem, ample evidence of its existence was forthcoming throughout the interview.

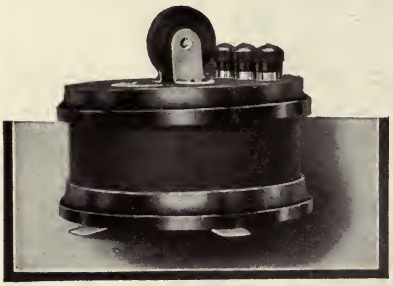
Mr. Turney first conducted his visitors to the little testing laboratory wherein each of his new devices tells its story, and a bright cheerful den it is. Of diminutive size, but withal, large enough, the "lab" is a picture of orderly efficiency. If the instruments in it pay a tribute to the inventive genius of the owner, no less is the systematic atmosphere of the testing room a graphic illustration of Mr. Turney's business instincts.

The editorial mind is trained to skepticism, but nevertheless it is always open to conviction. That is to say, we who hear daily—yes, almost hourly—of new achievements and devices, are prone to accept all statements with "a grain of salt" until we are shown; then we are ready to tell what we have seen with our own eyes or heard with our own ears. This, then, was our attitude as we entered the quiet little testing room.

Our attention was first called to the new Crystaloi detector which is clearly Mr. Turney's pet. This device was described several months ago in MODERN MECHANICS, but for the benefit of new readers the essentials of its construction will be reviewed briefly.

The detector appears to be an idealized form of coherer, having all of the desirable features of the latter with none of its disadvantages. The active material is in the form of a finely granu-

lated alloy held in a chamber between a sensitive crystal and a silver contact surface. The chamber forms the central



One of Mr. Turney's Latest Inventions—the Crystaloi Detector With a Special Cohering Inductance.

portion of a knurled wheel of insulating material which is mounted vertically between uprights in such a manner that it may be rotated. By turning the container, the alloy, which does not fill the chamber, is made to change its position with the result that the most sensitive point is found within a few seconds.

To sum up the active principle of the detector in the words of its inventor: "A comparatively large surface of a very sensitive mineral is brought into contact with a great many points of a very light, finely divided alloy which becomes a conductor only when traversed by high frequency oscillations."

So much for the detector itself; we had heard the story before and were ready to be shown. Accordingly the telephone receivers were brought into requisition and our surprises began. A pressure of the test buzzer key and a half-turn of the detector knob and we were ready for anything. A mere recount of the stations we heard would be of little interest and value, but it may be stated quite frankly that, judging by numbers, we did not miss many of the stations that were sending at the time. The signals were firm and clear, taking into consideration the various sources from which they came, and we do not hesitate to say that the detector proved itself to be a little marvel of convenience.

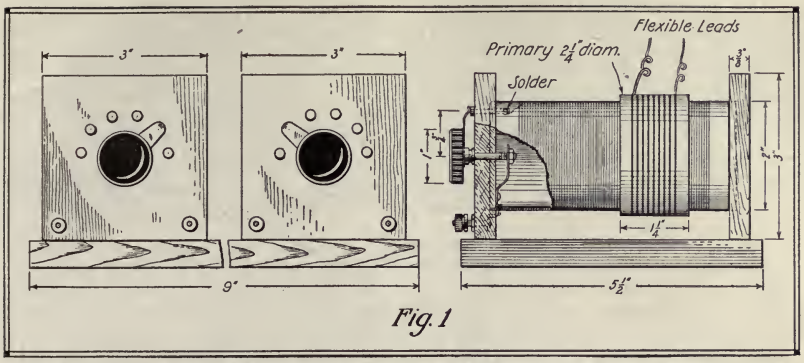
We had been listening but a few minutes when the strains of a Sousa march came to our ears, superposed upon the dots and dashes of the code; a radio telephone was in operation. A slight adjustment of the receiving transformer and we listened to an etheric band concert.

Throughout the tests, static was conspicuous by its absence. The writer shall not attempt to account for this characteristic, but the fact remains that it is marked. Mr. Turney merely states that the construction and principle of his device renders the receiving apparatus remarkably free from static interference and, without trying to explain something the inventor declined to elucidate, his visitors can heartily second the motion. As a matter of fact, there are several interesting points in connection with the action of the detector that would bear a technical explanation but for a' that, what are the odds? It works, and if the evidence of our eyes and ears is to be accepted, it works as well as the inventor claims.

Passing from the simple detector, the inventor called our attention to a new type in which is incorporated what Mr. Turney calls a cohering inductance. This inductance, when properly proportioned and connected in the circuit, causes the alloy to cohere more firmly, which reduces the internal resistance and makes the detector considerably more sensitive. In the new type, the inductance is enclosed within the base of the detector and is properly connected in the circuit.

Mr. Turney has a number of interesting devices in process of development, among which are a variable condenser of radical design and an attachment for a receiving transformer which the inventor has named an "exploring inductance."

Our visit to Mr. Turney's laboratory brought out the fact that his is but another case of the serious experimenter turned inventor and finally manufacturer. This gentleman has had the sagacity to concentrate all of his efforts on one product until he has brought it up to a state approaching perfection. Success inevitably awaits the man who follows this path, providing his product has a market and is properly exploited.

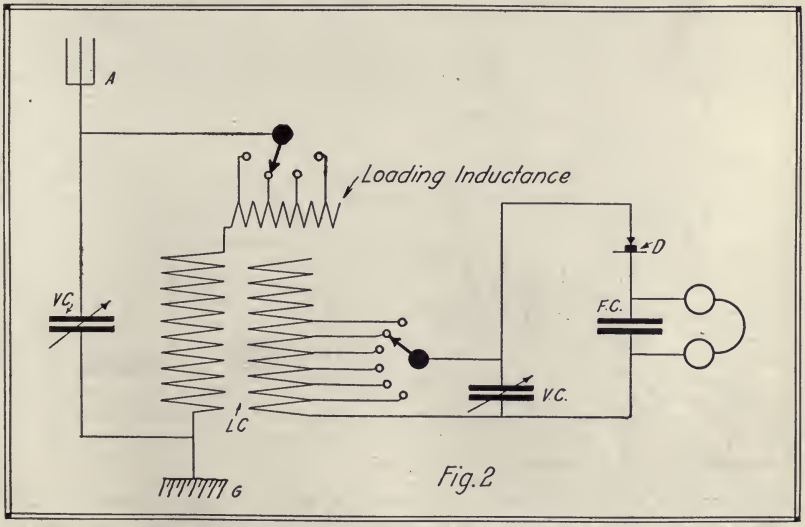


End and Side Elevations of a Small Multiple Tuner That May Be Used With Good Results for Close Tuning.

A NEW TUNING APPARATUS

BY the use of only a few turns on the primary of a receiving transformer and supplying the necessary tuning inductance with a tap loading coil, the sharpness of incoming signals is increased.

The small multiple tuner here shown makes possible more selective tuning than can be obtained with the ordinary loose-coupler. It will be noticed that the primaries have only a small number of turns. This eliminates dead end effects to some extent. There are no variations on the primaries.



Scheme of Connections for Using a Single Tuner for Receiving Wireless Messages.

The writer has found that with the ordinary loose coupler the coupling is varied very little. This is due to the fact that most all stations are tuned so that their waves have a decrement precisely the same.

Since few turns increase selectivity and since the coupling need be varied only minutely, it is possible to make a receiving transformer that is very compact and quite simple to adjust.

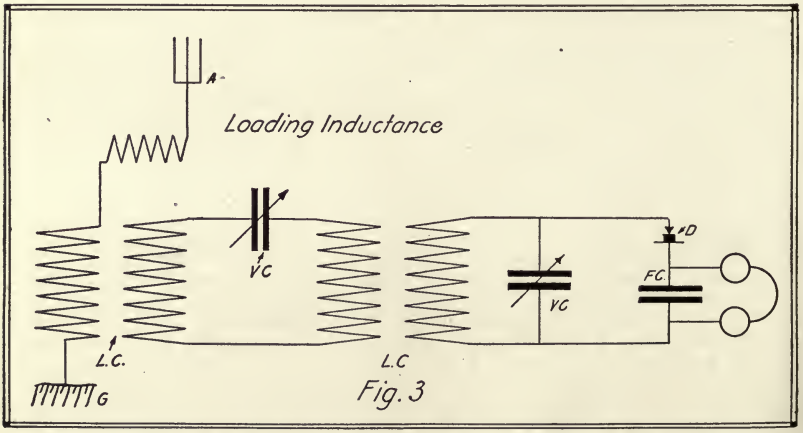
Now a few facts as to the construction of the tuner. The primary and secondary tubes can be made of mailing tubes. Six taps are brought from the secondary to a switch at the end of the coil. The primary consists of ten or twelve turns of No. 22 D. S. C. wire and connections are made to it by two flexible leads. Each secondary is wound with No. 28 D. S. C. wire, beginning ⅜ inches from the ends.

Two of these couplers are required to make a multiple tuner and they should be mounted on a base as shown in Fig. 1. Fig. 2 shows the connections for a single coupler, while Fig. 3 shows the hookup for a double transfer circuit that is excellent for selective tuning. Since the two coils are of only slightly different diameter, the space between them can be filled in by wrapping heavy paper or cardboard around the secondary before slipping on the primary tube. The coupling should be varied until a spot is found where all stations come in good. Then the coupling need not be changed. The use of variable condensers for sharp tuning is recommended.—IRVING FARWELL.

TESTS OF A NEW WIRELESS TELEPHONE SYSTEM.

From the Pacific Coast comes the report that a distance of 721 miles has been covered with the wireless telephone system of H. P. Dwyer, of San Francisco, Calif. Unofficial tests were conducted between Tatoosh, Cape Flattery, and the Government station at Mare Island. It is said that the conversation proved perfectly clear and understandable despite the great distance. A power of 4½ kilowatts was employed in conjunction with an aerial suspended from a 300-foot tower.

Details of the Dwyer radio telephone system are not available at the present moment, but in an early issue of THE WORLD'S ADVANCE there will appear a complete description of the system, with particular attention to the technical details, when these are disclosed by the inventor.



Scheme of Connections for Using Two Tuners for Receiving Wireless Messages. This arrangement permits of a high order of selectivity.

CONTRARY *to the prevailing opinion among those interested in wireless telegraphy and telephony that nothing new or startling is being accomplished in this field, an interview with Dr. Lee DeForest discloses several radically new ideas that are being put into practical use.*

THAT nothing really new has been introduced in the field of radio communication during the last few years is the prevailing opinion among those who are closely following the development of the art. And this opinion is borne out by facts if we are to judge by the equipment used in everyday work. Modern commercial stations employ apparatus built in about the same manner as that of several years ago; although in fairness it must be admitted that in most instances the various instruments show many refinements in design. Yet nevertheless, despite all the ingenuity that may be displayed, there are few instruments or systems that can lay claim to being an absolute novelty—a something that is radically different.

I have been one of those who share the belief that no actual progress is being made in the wireless field; but after a visit to the laboratory of Dr. Lee De Forest, the well-known pioneer in this class of work, I am obliged to tender my resignation as a member of the pessimists club since I am firmly convinced that much is being accomplished along entirely new lines and that we are on the eve of many surprises.

It was a Saturday afternoon not long ago that I took advantage of the invitation extended by Dr. DeForest to visit his laboratory where he had prepared several interesting demonstrations for a party of us. We traveled up to the High Bridge station by electric train and within a short space of time found ourselves at the door of a two-story brick building, with the Doctor there waiting to greet us.

The first surprise in store for us was an exhibition of the audion amplifier. The outfit in this case comprised a large oak cabinet with a hard rubber front on which were mounted numerous switches, binding posts, adjusting handles and three amplifier bulbs. The amplifier, our host explained, is one of the outcomes of his experiments with the audion. An amplifier bulb is built along the same lines as the audion, differing only in the particular that it contains two plates instead of one. By the employment of the amplifier apparatus it is possible to magnify even the weakest electric currents many times.

"I have here an ordinary telephone receiver such as you can buy at any supply store for about fifty cents," said the Doctor, indicating a receiver of the Bell type lying on the demonstration table. "You all know what a poor microphone a receiver of this kind is. I have ac-

cordingly selected it for demonstrating to you the audion amplifier."

The telephone receiver was soon connected to the amplifier apparatus, and the Doctor announced that we could now listen to its microphonic capabilities, using the first step of the amplifier. Upon placing the receiver over a watch the ticking of its movement could be clearly heard, although not loudly. But upon throwing in the second step of the amplifier the ticking of the watch proved to be quite loud. Not alone the ticking but even the slightest touch of the fingers on the table were audible in the telephone receivers. Doctor DeForest then connected in the third or last step and bade us listen to the sensitivity of the receiver microphone. No longer did the ticking of the watch seem natural—it was far too loud to ever be considered as such. Slight taps on the table were heard in the telephone receivers as loud crashes. Even a person walking about the room caused considerable disturbance in the head band receivers.

To my query as to how many times the amplifier increased the sound produced by the receiver alone, our host replied:

"From my numerous experiments I have found the first step to amplify from six to ten times. Of course, you understand that all amplifier bulbs are not identical and some prove more sensitive than others. However, from six to ten times amplification may be expected from a single step. The second step amplifies the current of the first step from six to ten times, giving an amplification thus far of from 36 to 100. The third step increases the current of the other two steps again from six to ten times, resulting in a total amplification of 600 to 1000, depending on the efficiency of the bulbs. It is difficult for the ear to grasp the meaning of one thousand amplifications. In fact, the ear at best is a very poor judge of comparative strengths of sound. I have based my estimates of the capabilities of the amplifier on tests made with an audibility meter."

One of us inquired whether the amplifying process could be continued several more steps—or even indefinitely. The answer to this uery surprised us:

"I have tried four steps," replied the doctor, "but find the current so powerful that it paralyzes the audion bulb in the last step. By this I mean that the powerful current renders the bulb inoperative at times. Furthermore, the amplification is so great—in the neighborhood of ten thousand times—that even the slightest sounds cause a roar in the receivers. This is far from desirable and soon becomes indeed troublesome. I have therefore come to the conclusion that the three step amplifier is the practicable limit."

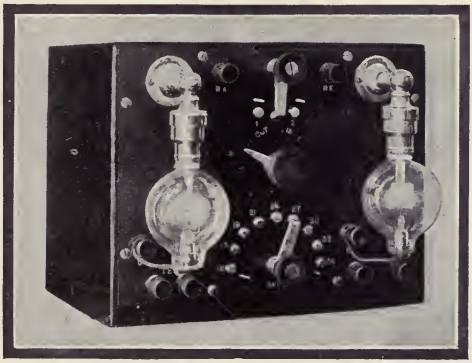
Our host then proceeded to connect up an audion receiving set with the amplifier. Two sets of telephones were placed in circuit with the apparatus; one directly to the audion set and the other to the three step amplifier. What a difference in the signals! Even the signals that sounded so faint and distant when using the audion alone came in as loud as if the stations were suddenly transported into the adjoining room, when using the amplifier. And the wonder of it all was that the amplifier did its work without any distortion of sound nor objectionable noises.

Being of a curious disposition, one by one the members of our party at different times had wandered about the laboratory, studying and drinking in with his eyes all the interesting things laying about in both finished form and in process of development. What had been the center of attraction for all of us was a huge cabinet receiving set with a hard rubber front on which were mounted numerous switches, binding posts, handles and an audion bulb. Its name plate bore the legend: "Navy Type Ultraudion Receiving Set."

Dr. DeForest intercepted us before we could ask him concerning this new center of attraction:

"That is a special receiving set which we have built for our exhibit at the Panama-Pacific International Exposition. I intend leaving for San Francisco in a few weeks' time and I shall take this set and several other outfits with me. I am going to show you several features of this set and shall also try to pick up some long distance stations for you; Hamburg or Nauen, for instance."

The Doctor explained briefly the principle of operation of the ultraudion set which, it appears, is to use the audion bulb as a generator of undamped oscillations. By means of elaborate adjustments of capacity and inductance it is possible to have the bulb generate currents of any desired frequency. Incoming signals of the undamped variety are heard in the receivers as long and short blasts of a whistle, or "beats," as they are technically termed. These beats are produced by the difference in frequency between the current generated by the audion bulb and that of the incoming waves.



The Audion Detector—One of Dr. DeForest's Inventions—Has Been the Foundation for Many of His Subsequent Devices.

Unfortunately we did not succeed in hearing any long distance signals with this set. As the Doctor explained, hunting for signals of long wave lengths with this receiving set which tunes so sharply is analogous to searching for the proverbial needle in the haystack. One man employed in the laboratory has spent much time in getting accustomed to the adjustments of the set and is able to pick up many of the European long-distance stations, as well as the stations of the Amalgamated Radio Company on the Pacific Coast. Strange as it may seem, although the Doctor is the designer of the set and is intimately familiar with every part of it, he frankly admitted that he did not have the knack of picking up stations with it.

By this time the conversation drifted to wireless telephony, since we all knew of the extensive experimenting of Doctor DeForest in this field. To add to our interest there rested on the floor of the laboratory a huge arc generator equipped with a magnetic field and a system of water cooling. Our host said that this was one of his old arcs with which he had been fairly successful, although more recently he was devoting most of his attention to radio telephone systems using a form of quenched gap and those employing an audion bulb as wave generator.

"I have succeeded in bringing to a commercial stage two forms of wireless telephone. One of these utilizes an audion bulb as the generator of the high frequency current. Of course, you probably have read of the audion as a wave generator and accordingly appreciate that thus far it is for the most part only applicable to short-distance work. But this system has the beauty of being so simple that it can be operated by almost anyone. My other system, which employs a quenched gap, can be used for greater distances and the voice carries well. With the latter type of sets it is necessary to employ a high frequency alternator.

Later, when Dr. DeForest brought us down to the large machine shop, where his commercial products are turned out, we were surprised to see the practical appearance of his wireless telephone sets. The present sets follow the general lines of conventional wall telephones and are but a trifle more complicated to operate.

"I believe that some one will succeed in talking across the Atlantic ocean without wires within five years' time," said the Doctor in reply to a query. I might even add without hesitation that it is a possible achievement today with the apparatus thus far developed. Given a sufficient sum of money with which to conduct extensive experiments and pur-

A Wireless Telephone Set That May Be Carried About in a Motorcycle Side Car Bids Fair to Become an Important Factor in Military Operations.

much ingenuity was displayed in designing different portions of the sets, the oscillation transformers in particular. These panel sets are entirely self-contained with the single exception of the alternator for supplying the current. We were also shown a large variety of audion receiving sets with many innovations in the way of tuning apparatus.

Suggested by the present European war there has been recently completed a wireless telephone set that may be carried about by a motorcycle equipped with a special side car. Our host told us that the set had a fair range and would probably prove more convenient than some of the existing portable radio telegraph sets now used by the belligerents. The set employs the quenched gap type of wave generator and is designed very much along the lines of a wall telephone set. The receiving set is of the audion type and, together with the transmitting equipment, forms a compact and rugged unit for work in the field.

chase the necessary extensive equipment, I feel confident that I could talk to Europe by wireless telephone in a few months' time."

The Doctor called our attention to compact and cleverly designed wireless telegraph sets that employed a quenched gap. The workmanship was perfect and

A few more minutes of discourse and we were bidding the Doctor good-bye and making our way to the railroad station; I, for one, convinced that something new is being accomplished in the wireless field and that we are on the verge of a big step forward in this branch of communication.

AMERICAN RADIO RELAY LEAGUE STATION

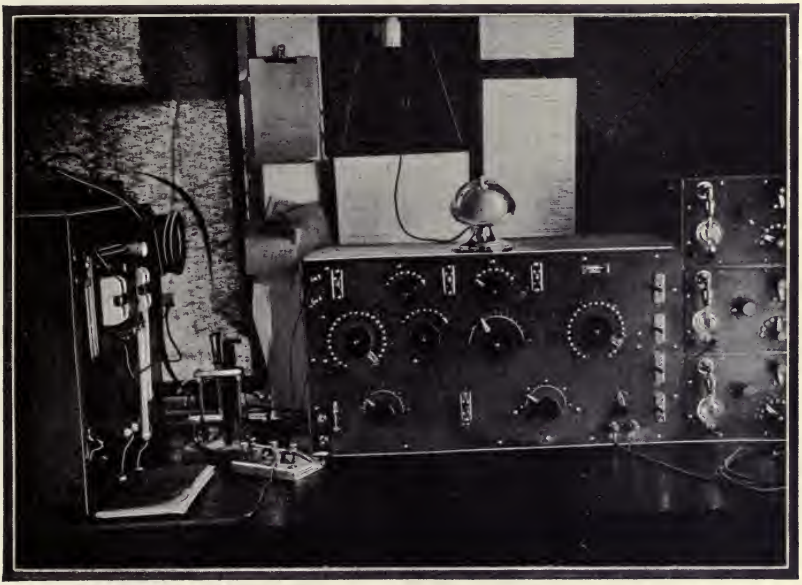
THE wireless station of George C. Cannon of New Rochelle, N. Y., which is illustrated in the above view, is a model of good design and efficiency.

In the center of the illustration may be seen the hard rubber front of the oak cabinet containing the tuning apparatus for receiving. A special loose-coupler designed by the owner is used in the receiving set, permitting of tuning for wavelengths up to 3,200 meters, while a loading coil that is used in conjunction with it and which adds inductance in both the primary and secondary circuits tunes the set up to 8,000 meters. A condenser is placed in the ground circuit to enable short wavelength signals to be received. Although a condenser is used in tuning

the secondary of the loose-coupler, but little capacity if any, is needed, because of the great inductance value of the secondary winding. In the primary circuit it is possible to tune to one turn of wire. The degree of coupling can be altered within a wide range. The detector used is an audion, together with a two-step amplifier, the different degrees of amplification being immediately secured by the manipulation of switches.

The transmitting set is of one kilowatt capacity and is placed in a polished cabinet, a portion of which appears at the left. By using a very small condenser and a high speed rotary gap—one that operates two or three times as fast as that of an ordinary set—together with close tuning and a fairly loose degree of coupling, the transmitter is capable of covering long distances on a short wavelength and with an aerial of medium height.

As for the efficiency of the station, Mr. Cannon states that it is possible to read signals from the Key West station when standing 15 feet away from the telephone receivers. With a loud speaking telephone the signals from Arlington can be read over 100 feet from the instrument. On the other hand, the transmitter has been tested out for eight consecutive nights with Rockland, Me., approximately 350 miles away in a direct line. Signals from the station have been copied 800 miles away on exceptional nights.



Wireless Station of George C. Cannon of New Rochelle, N. Y., One of the Stations in the American Radio Relay League Chain, Incorporates Many of the Latest Ideas in Radio Engineering.

THE FARMINGTON VALLEY RADIO CLUB

In April, 1914, the wireless society known as The Farmington Valley Radio Club was organized in the Simsbury, Ct., High School. At that time it had a membership of four. A room in the school building was given to the club for use as a wireless station, and soon after a one-quarter KW equipment was installed. Today the club has a membership of over twelve.

What the World is Doing

SEVERAL weeks ago a reader of this magazine wrote in stating that he and his friends had been conducting experiments with foreign and American wireless instruments, the outcome of which proved the latter to be superior in almost every way. This is not surprising to anyone familiar with the radio apparatus of European manufacturers and those of American make. The former are often more elaborate and the workmanship cannot be surpassed. But while the foreign radio apparatus may prove quite suitable for the conditions of operation existing in Europe, American operators prefer the more rugged and practical American instruments, even if the finish does not happen to be so elaborate. And these same differences are evident in most electrical apparatus. Almost invariably the American products will be found more substantial and easier to handle, while the foreign ones will present perhaps better care in the matter of finish. Since the war in Europe shut off a good portion of the goods formerly imported from the countries at war, Americans have begun to appreciate more and more the capabilities of domestic manufacturers. Previously, many of us were apt to prefer imported products to our own and this for the reason that we did not know our own products. Most of us have now come to appreciate the real meaning of the legend "Made in America" on different products, and the future will witness even greater enthusiasm in domestic manufactures.

"PRACTICAL Men in the Making" is the title of an article in this issue that is worthy of more than passing note. It affords a graphic illustration of the fact that this present age of ours is alive to the importance of making useful men of our growing boys. Time was when a man would say with perhaps a touch of disdainful pride, "Mechanical? No, I cannot even drive a nail." He may say it to-day, but there's little satisfaction in saying it when perhaps his twelve-year-old son is the proud possessor of an artcraft lamp, a piece of mission furniture, or a radio outfit made with his own hands. While his daddy looks helplessly on, the boy puts up shelves in the kitchen, repairs the household furniture, installs electric bells and changes the location of the electric lights, and makes himself generally indispensable in the home—just as he is destined to make himself indispensable in the office or factory in years of maturity. No, Friend Reader, not perhaps through being able to install lights and repair furniture, will he be a power in the business world, but because his early training has developed in him a wonderful resourcefulness—an ability to meet and conquer obstacles.

In short, the net result of the practical training given the boy of to-day is to quicken his powers of observation and analysis—to enable him to pick out the weak places in any problem set before him regardless of its nature and to equip him with a self-confidence that is backed by ability and experience.

It is gratifying to the Editors of this magazine to note that the editorial policy inaugurated eight months ago as an experiment has proved to be so thoroughly sound now that it has stood the test of time. Perhaps the strongest evidence of its soundness is given by the several educational institutions which have adopted the very same policy in their courses of instruction. What this magazine aims to do with both men and boys, the schools are doing with the younger generation; making of them practical men—men who accomplish things—in the fullest sense of the word.

He Certainly Had

The chef was interviewing the young man who had applied for work.

"Have you had any experience in the lunch business?" he asked.

"Why, I should say so," replied the energetic youth. "I've been lunching for almost 20 years."—*Lippincott's.*

It All Depends

Boss (to office boy)—If any one asks for me, I shall be back in half an hour.

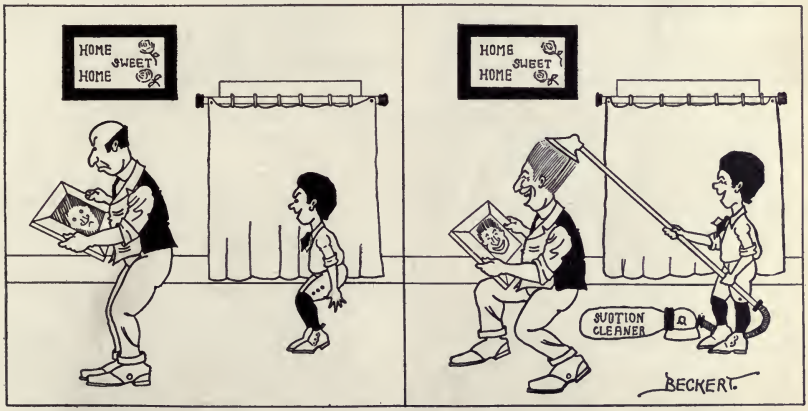
Office Boy—Yes, sir; and how soon will you be back if no one asks for you?—*Boston Transcript.*

A Clever Answer

The two oldest inhabitants were very ignorant, neither of them being able even to tell the time of day. A friend of Uncle Ben's gave him a watch, of which he was very proud. One day, before the crowd at the corner store, old Pete, being slightly jealous of such wealth and wishing to embarrass his rival, said, "Say, Ben, what time have ye got?"

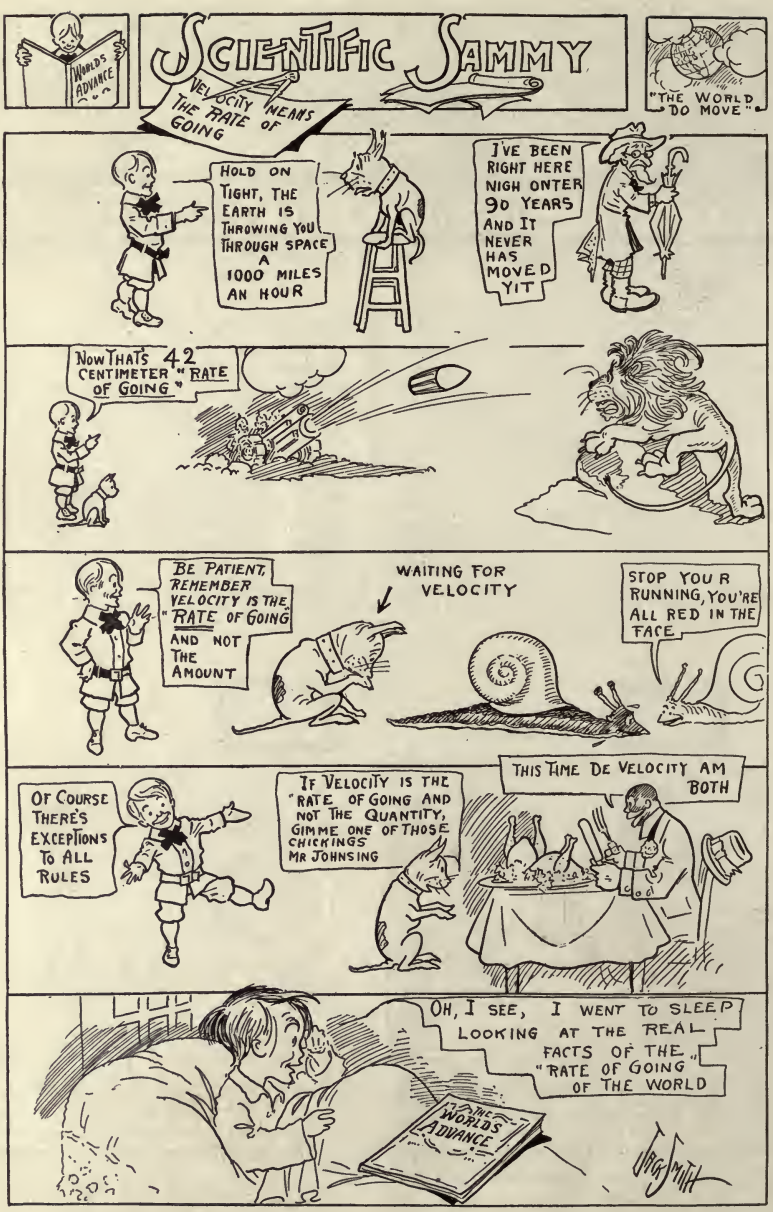
The other old fellow drew out his watch and turned its face toward his inquisitor. "There she be!" he exclaimed.

Pete was almost at a loss, but he made a magnificent effort and retorted, "Blame if she ain't!"—*Everybody's.*



Dad: Were it not for that dome of mine
My looks would sure be mighty fine!
Kid: By golly, dad! I'm not a dreamer;
I've got a scheme—the vacuum cleaner.

Dad: The suction works, hair grows like thunder,
Ingenious Gene, you are a wonder!
Kid: The world would gain, if people knew
What electricity can always do.


WORLDS ADVANCE
SCIENTIFIC SAMMY
VELOCITY MEANS THE RATE OF GOING
"THE WORLD DO MOVE"
HOLD ON TIGHT, THE EARTH IS THROWING YOU THROUGH SPACE A 1000 MILES AN HOUR
I'VE BEEN RIGHT HERE NIGH ONTER 90 YEARS AND IT NEVER HAS MOVED YIT
NOW THATS 42 CENTIMETER "RATE OF GOING"
BE PATIENT, REMEMBER VELOCITY IS THE "RATE OF GOING AND NOT THE AMOUNT
WAITING FOR VELOCITY
STOP YOUR RUNNING, YOU'RE ALL RED IN THE FACE
OF COURSE THERE'S EXCEPTIONS TO ALL RULES
IF VELOCITY IS THE "RATE OF GOING AND NOT THE QUANTITY, GIMME ONE OF THOSE CHICKINGS MR JOHNSING
THIS TIME DE VELOCITY AM BOTH
OH, I SEE, I WENT TO SLEEP LOOKING AT THE REAL FACTS OF THE "RATE OF GOING" OF THE WORLD
THE WORLDS ADVANCE
JAS. SMITH

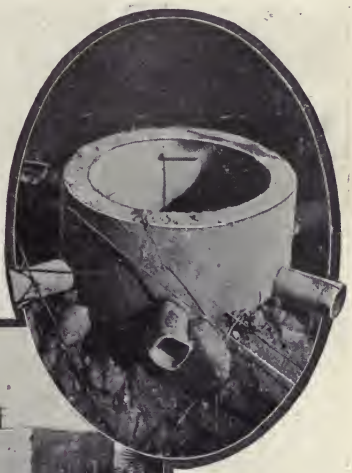
The World's Advance

Vol. 30 MAY, 1915 No. 5

UNDERGROUND CONCRETE IRRIGATION SYSTEM

The concrete underground irrigating system is the latest thing for watering citrus groves of Southern California. After years of experiment grove owners declare that the new system is the final word so far as this irrigating business is concerned.

The new irrigation system consists of a pressure box and a series of small stations, one of which is placed at the head of each row of trees. In size the pressure box is 4½ feet high, 3½ feet long and 2⅓ feet wide, outside measurements. Inside it is about eight feet deep, being sunk a trifle less than four feet in order that the water main may be reached. In this box there are two compartments, the water entering in one side, then passing



At the Left: The Pressure Box of the New Concrete Irrigation System. Above: One of the Concrete Stations with Connecting Pipes.

through the water gauge at the center of the top of the partition and out the other side into the pipes of the irrigating system. This water gauge in the partition is exactly a foot square and in this way the feet-hours of water used are measured, doing away with an expensive meter.

From the box the water runs through the eight-inch main of the system to the stations. These underground pipes and the stations are of cement. The station is round and has a wall two inches thick. Around the station are six openings with their private shut-off caps, while at the bottom of the station there is a "turn-off" valve. Six ditches are made between each two rows, and the water from three openings in the stations at the head of the two rows running alongside is accommodated by the six ditches. This system is as much as possible "out of the way" and makes the irrigating of these groves comparatively simple, yet very effective.

A NEW TRENCH-DIGGING MACHINE

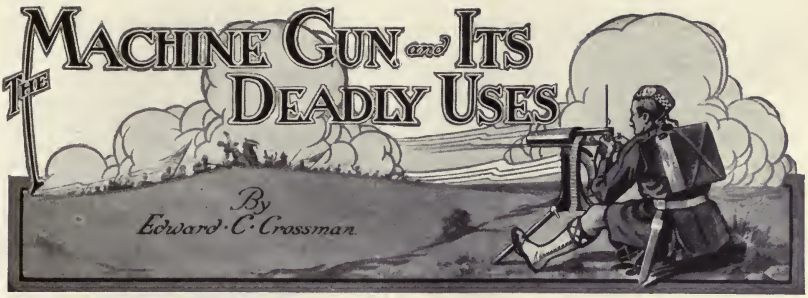
A machine that does the work of scores of laborers has lately come into use for making trenches and ditches. The new traction ditcher requires but two operatives and its adjustments are so numerous that it seems to be possessed of human intelligence, as one watches it in operation.

A New Trench-Digging Machine that Operates at the Rate of Four Feet of Trench Five Feet Deep and Two Feet Wide Per Minute.

The ditching machine is self-propelled; steam furnishing the motive power. The excavating is done by means of a large wheel with scoop pockets at the contact points. A derrick regulates the depth at which the wheel excavates. All the manipulation is under the control of one man, the only other helper being the fireman. As the pockets invert they deposit the dirt on an endless belt, where it is conveyed a short distance from the trench. The machine will excavate a ditch or trench at the rate of four feet per minute, making it five feet deep and two wide.

GROOMING HORSES BY ELECTRICITY

The Park Department of New York City has inaugurated an innovation in the grooming of its horses. Instead of using curry combs in the usual manner, they are now being employed in connection with a vacuum cleaner. Thus not only is the horse groomed properly, but the dust, scale and dandruff are thoroughly removed from the animal's coat and deposited in the receptacle of the suction cleaner. Aside from the grooming being more thorough, it is said that a great saving in time is effected, a man using the vacuum cleaner being able to care for several times the number of horses he formerly could curry in the old way.



SHOOTING *at the rate of six hundred rounds per minute, the machine gun is considered by many the most effective of modern weapons. It has done much to eliminate the old-time dash and vividness of warfare, rendering battles of today a matter of science in man-killing.*

JUDGING by the titles of some of the photographs printed about the country on the war subject, the machine gun is an unknown animal to most of our newsgatherers. They apply the term indiscriminately to real machine guns, and to coast defense ordnance and field artillery and mountain batteries. It is like the term "marine," which every newspaper man insists on hanging around the neck of very obvious blue-jackets shown in photographs and other illustrations.

Gun Kick Put to Work

A machine gun, as the term is used in military parlance, is an automatic rifle actuated by its own recoil and firing continuously as long as its belt or clips hold out and the trigger is held back. In some models, such as the Benet-Mercie, the simple turn of a knob converts the arm to a self-loading rifle in which the recoil does the work of ejecting empty case and inserting a new one, but does not fire it. With this adjustment the operator has to press the trigger for each shot, just as with the many types of self-loading pistols and rifles and shotguns now on the market.

In its own province, however, the machine gun does all the work so long as it is kept supplied with ammunition. The recoil of the cartridge, or the work of the powder gases, taken from the barrel at a little gas-port, functions the extracting and cocking and loading mechanism, and again fires the gun when the breech is closed. The operator has merely to keep the gun on the mark. The gun crew keep the hungry monster supplied with belts or clips filled with cartridges.

The rate of fire of such a gun is tremendous. By the sound one can grasp the meaning of 600 shots a minute, the number that such a gun can squirt out if worked to a maximum speed and kept filled. The sound of such a gun is practically that of a pneumatic riveter working on a steel frame building—when the riveter is working very fast.

Contrary to some beliefs, the gun is rarely used for long stretches of shots

—uninterrupted volleys of perhaps a full minute's duration. In rare circumstances this might be done, such as troops in close order charging close at hand, offering therefore a large mark and every inducement to shoot quickly while the shooting is still possible.

The cartridge is almost invariably the same cartridge used in the infantry rifles of that army. The reason is obvious—ammunition supply is simplified and the guns can be fed from any infantry reserve store.

Constant Firing and Diminished Accuracy

As all modern military cartridges develop considerable recoil, a string of shots from the gun will jar it off the mark and necessitate relaying it again. This is true even with the heavy 150-pound gun and tripod of the Vickers-Maxim, formerly used in the American service, and now readopted after careful trials against the Benet-Mercie.

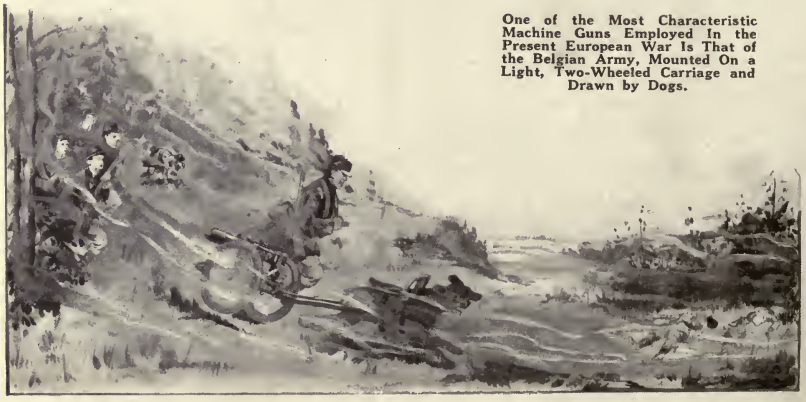
The fact that the constant pounding of the powerful cartridges jars the gun off the mark, necessitates firing a machine gun in short bursts of shots, perhaps 15 or 20 at a time say for two or three seconds, then a pause while the pointer relays the sights, then another burst, and so on.

This is quite apparent even at short range. The writer, firing a Benet-Mercie some years ago at 20 yards, let go one burst of shots that numbered about 35. At this 60-foot distance the three-score bullets made a narrow slit in the paper, little wider than a bullet, but seven inches from top to bottom. The last shots fired were the highest, of course. At 1000 yards this would have meant missing the mark 30 feet or so with the last shots, outside of all other causes.

Unhappily one cannot gallop up to a gun of this sort that is out of ammunition, hurl a bandolier or two in its maw just as said bandoliers came off an infantryman's back, and then start its chatter. They require special containers, clips of 60 rounds, belts or something of the sort, from which the feed mechanism can pluck or drive the cartridge.

The present American machine gun, the Benet, uses long, flat brass clips holding 60 rounds of the regular sharp-pointed infantry ammunition. The end of the clip—held horizontally—is slipped into the gun, and then the monster bites the cartridges out as it forces the clip across from side to side and finally throws it out. The Colt and the Vickers-Maxim use a woven belt, not unlike those generally employed for carrying cartridges. These hold 250 rounds each and are filled by a little device called a belt-filler.

Both the present gun and the two just mentioned are accompanied by a number of thousand rounds of ammunition, packed ready for use in these containers.



One of the Most Characteristic Machine Guns Employed In the Present European War Is That of the Belgian Army, Mounted On a Light, Two-Wheeled Carriage and Drawn by Dogs.

No Army In the War Has Made Better Use of the Machine Gun Than the German Army. Both On the French and Russian Fronts the Germans are Amply Supplied With Machine Guns That Serve to Shatter and Discourage Many an Attack by Their Opponents.

The Benet gun is very light, weighing around 30 lbs.—well within the capacity of anyone's strength when it is to be moved about. It has no tripod, but has a short, adjustable rest at the butt that is used by the pointer, who lies prone behind the gun, and a pair of short legs near the muzzle.

Where Lightness is a Drawback

The very lightness and handiness of the Benet gun constitute an objection in that the recoil promptly gets the gun off the mark. The Vickers, now readopted for the American service, is mounted on a heavy tripod, and the gun itself is quite heavy, this outfit totaling about 100 lbs. The pointer sits on a little seat on the tripod, helping to hold it steady against the throb of the firing. This gun is cooled by a waterjacket surrounding the barrel, while the Benet and Colt are air-cooled.

The Benet is furnished with a pair of spare barrels, which are to be inserted in the gun every few hundred shots, letting the fired barrel cool off in the interval. The changing of barrels requires but a moment's work.

Machine Gun Fire vs. Rifle Fire

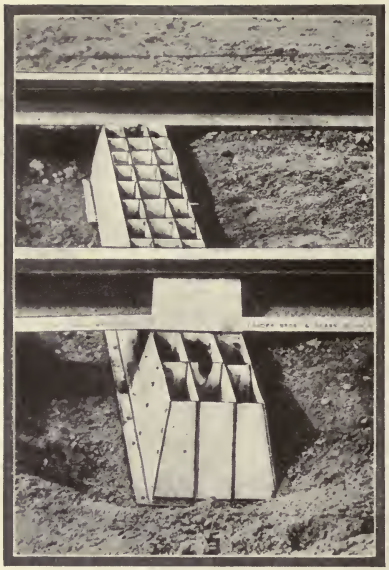
Queerly enough, tests made years ago at the School of Musketry at Monterey by the American army developed that the machine gun, in the hands of skilled crews, is more accurate at the very long ranges than infantry fire. Shot for shot, the Vickers gun firing 600 rounds from 2000 yards down to 1000, beat a body of 50 expert riflemen firing the same number of rounds. On a skirmish target of 89 figures of men, the machine gun inflicted 39 hits on 29 targets, out of the 600 rounds. The infantrymen inflicted 20 hits on 17 targets in the same number of shots. One of the ranges was unknown, the distance not told either to machine gun crew or to the infantry.

On a huge collective target of 176 figures, the machine gun fired 400 rounds, from 2,000 down to 1,200 yards, making 89 hits on 65 figures. The infantry made 74 hits on 52 figures.

In the time used at the firing points in both preparation and firing, the infantry and gun ran about the same, but the machine gun used a far larger portion of the time at the firing points, in actual firing, thus showing that it could be brought into action promptly and lost no time in reducing jams and trouble.

The weak point of the machine gun is its liability to jams. Trained men recognize the trouble, however it may occur, but untrained men may have a gun jam from defective cartridge, wet belt, ruptured cartridge case, or other cause and be unable, through their unfamiliarity with the gun, to reduce it promptly.

In the American service, every regiment is accompanied by four machine guns and their accessories. The guns and the ammunition, packed in wooden cases, are carried on pack-mules.



If the Claims of the Inventor Prove True, This Steel Tie Will Eliminate Railroad Wrecks Due to Defective Rails.

STEEL TIE TO PREVENT WRECKS?

A steel railroad tie has recently been perfected which the inventor claims will do away with a large percentage of railroad wrecks. The new tie absolutely prevents rail spreading, the most frequent cause of wrecks, and on account of its peculiar surface it makes an excellent cattle guard also. For the same reason, human trespassers would have a difficult time following a railroad track on which these ties were used, and consequently the yearly death rate of 5000 persons from that cause would be greatly diminished.

Careful tests of the new ties on a railroad in Oklahoma show that they have wearing properties at least five times as great as wooden ties. No spikes are necessary, and for the reason that they are self-gauging, the working gang can be decreased to one-half its usual size. In large quantities the steel ties represent a saving to the railroad of $320 per track mile.

A strong argument in favor of the new tie is that the enormous depletion of the American forests could be checked to a large extent.

AN IMPROVISED MOTOR ROAD SCRAPER

Instead of discarding as worthless a number of old road scrapers and buying new ones, the street department of a western city conceived the idea of removing the front wheels of the scrapers, attaching a pinion to the forward part of the frames and using them as trailers on the new motor trucks that the city purchased.

Thus rigged the scrapers can be used for either earth removal work or in snow removal. The powerful motor trucks can attain a speed and a hauling strength that was impossible with the horse-drawn scrapers in their original shape.

As snow and ice removers the old scrapers are more than paying for themselves, while the wear and tear on the trucks is not as much as if they were working under a load.

OPERATING TABLE FOR HORSES

In Boston's new animal hospital, the most modern in the country, there has been installed a special operating table for horses. The table itself has the form of a tipping rack, which can be moved from a vertical position to a horizontal position.

By the proper arrangement of straps, blocks and tackle, the horse can be firmly fastened to the table while in its vertical position. As the table is swung into its horizontal position by means of a geared crank, the animal is slowly lifted off its feet and finally is stretched out in a horizontal position, ready for the veterinary surgeon. When the operation upon the animal is complete and it is still under the anesthetic, the table top and the horse are removed to a room carpeted with tan-bark. There the straps are loosed and the animal placed on the soft floor to remain until it recovers its senses.

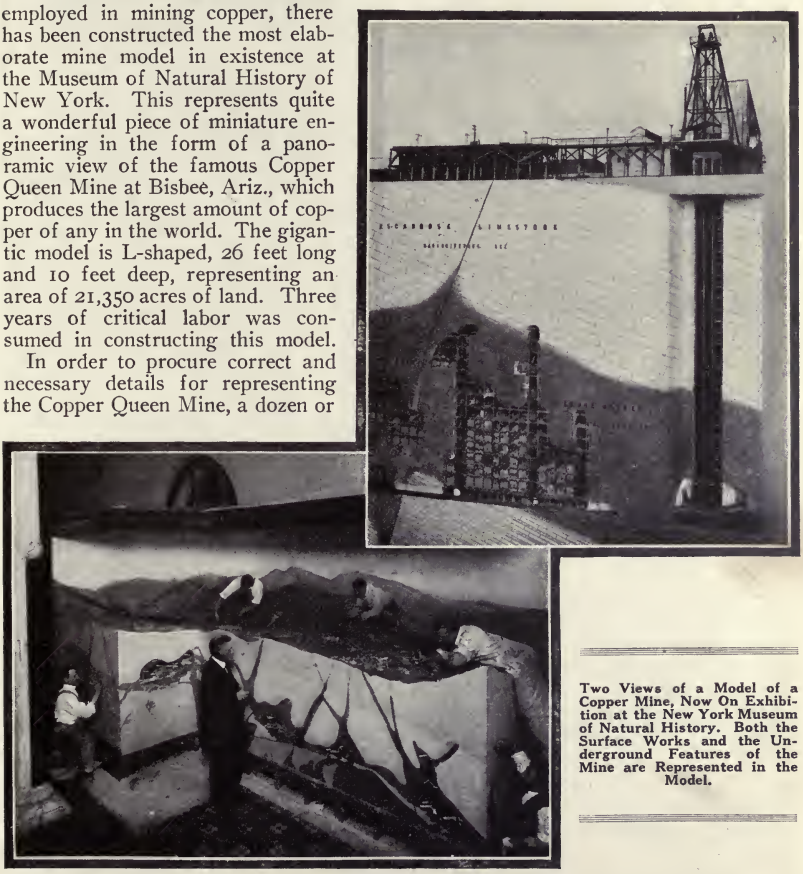
A WONDERFUL MODEL OF A COPPER MINE

THE copper industry and its methods of production are of exceptional interest just now, owing to the demand for this metal occasioned by the European war, as well as its extensive use in the commercial world for many purposes.

To illustrate the modern methods employed in mining copper, there has been constructed the most elaborate mine model in existence at the Museum of Natural History of New York. This represents quite a wonderful piece of miniature engineering in the form of a panoramic view of the famous Copper Queen Mine at Bisbee, Ariz., which produces the largest amount of copper of any in the world. The gigantic model is L-shaped, 26 feet long and 10 feet deep, representing an area of 21,350 acres of land. Three years of critical labor was consumed in constructing this model.

In order to procure correct and necessary details for representing the Copper Queen Mine, a dozen or more trained and skilled artisans, such as mining engineers, draughtsmen, map makers, painters, photographers, geologists and others spent many weeks at the mine obtaining data.

On the surface of the model there are represented more than one thousand dwelling houses, buildings, small structures and shaft houses, besides numerous railroad tracks, locomotives, cars, loading bins and other objects. These are made of brass, with the exception of the dwelling houses, which are of cardboard. To add realism to the model there has been painted a background of the surrounding hills made by a well-known



Two Views of a Model of a Copper Mine, Now On Exhibition at the New York Museum of Natural History. Both the Surface Works and the Underground Features of the Mine are Represented in the Model.

painter. The model is constructed on a scale of 24 feet to the inch.

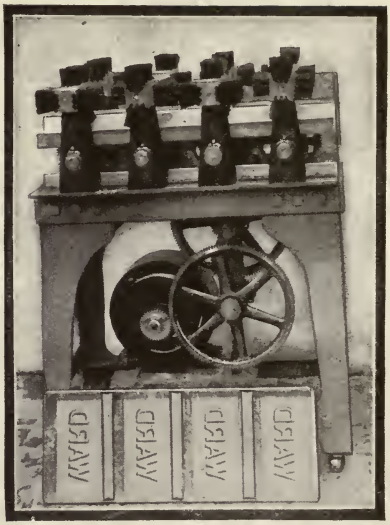
The sides of the model have been used to give the geological section along several vertical planes from 4,100 feet above the sea up to 5,900 feet on the Queen Hill. One of the interesting features of the model is the representation of a bit of the underground workings of the mine, showing tunnels, slopes, raises, shafts and various kinds of machinery, constructed to scale and inserted in their proper positions.

The yearly output of the big Copper Queen Mine is 75,203,813 pounds of copper. The model was built at the cost of $25,000 and presented to the Museum of Natural History through the generosity of James W. Douglass.

A TEAM OF TURTLES—SLOW BUT SURE

Of all strange teams, Master Rex Bassler, of Darien, Wis., probably has the strangest. He is here seen driving a team of eight turtles that were caught by his father, who makes a business of catching turtles. Blocks were placed in front of them to make them stand still long enough to take the photograph. Rex says his team is slow but sure. However, when he grows older he will likely want a speedier team than these turtles.

A Team of Eight Turtles Affords a Slow But Sure Means of Locomotion.



Two Thousand Bread Pans Can Be Cleaned and Greased Every Hour by Means of This Machine.

SCOURS AND GREASES BREAD PANS

Two thousand bread pans can be cleaned and greased in an hour by a newly invented electrical machine. The pans are scoured with stiff brushes and the grease applied with soft ones. One operator only is required.

Provision is made for the use of either direct or belt-driven motors, and either direct or alternating current will do. The machine is mounted on casters, so that it can be moved about easily.

A recent electrical invention is in the form of a latch for automobile doors that opens when a push-button is pressed. It is said to overcome some of the inconveniences of the usual hand-operated automobile door latches. Obviously, it is far easier to press a button than to tug at a stiff latch.

HOUSES THAT ARE BUILT LIKE BARRELS

Building small portable structures such as garages, summer houses, boat houses and the like in the shape of a barrel is a new idea in construction that has many advantages, perhaps the foremost of which is its readiness of assembling and dismantling.

The floor of this type of portable house is laid on light foundations. The ends are set up and the sides are placed around them like staves and secured by means of four large hoops of heavy iron. All the lumber is two inches thick and fits snugly by tongue and groove, so that no nails are required; only a few bolts being necessary to hold the structure together. The ends are units, with the doors and windows separate. There are no windows at the sides, which adds greatly to the ease of assembling. The result is that in an hour an unskilled workman can set up such a building; its dismantling being accomplished in even shorter time. It is said that children can do the simple work of assembling, as the parts are light to handle and easily fitted together. When dismantled a wagon will carry one of these houses in one load.

Following these lines of construction, a garage has been built by a Spokane designer, who found that it was adapted to many other purposes, such as bunk houses for mining camps and storage sheds for grain, as it is absolutely weather-tight when given a few coats of paint. No additional roofing is required over the staves. The low cost of a building of this sound and lasting construction is another valuable feature. About a hundred dollars will pay for a 12 x 14-foot structure suitable for housing a large car and with additional space for workbenches along both sides. In the west, where it originated, this type of garage has been adopted rapidly, and where it is placed on the grounds of a fine home, it is given an artistic appearance by the addition of a pergola in front and a few vines.

Many Advantages Are Said to be Derived from a Shelter Built Along the Lines of a Barrel. Here are Two Views of Such a Building, In Process of Construction and In Completed Form. The Absence of Windows on the Sides Simplifies the Work of Erection.

HOUSE MOVED ON A BOAT

That navigation should be included in the education of a house-mover was demonstrated recently in Chicago by a real estate dealer. This man saved several hundred dollars and many days of time by loading a house bodily on pontoons and barges, and towed it a distance of more than three miles along the shore of Lake Michigan to its new location.

The house in question was found unsalable in its former location, and accordingly the owner desired to move it to another property of his. However, he found that it would cost more to move the house three miles by land than it would be worth when he got it moved. He, therefore, decided to move it by water, as he figured that he could save money by so doing. In order to get the house onto the barges and scows on which it was to be moved, it was necessary to build a pontoon bridge. This operation had to be repeated when, an hour after the start was made, the house hove to the offshore side where it was intended to be landed. Fortunately, there were no squalls or other weather disturbances to interfere with the work, which required less than seven hours. The loading required three hours, the towing one hour, and the unloading about three hours. The expense of moving was $1,000, and the house owner estimates that in its present location he will have no difficulty in selling it for $6,000. This idea might well be taken advantage of by others under similar circumstances.

Moving a House by Means of a Large Scow Results in a Time and Monetary Saving if the Dwelling Is Located Near a Waterfront.

IT TAKES ONE-HORSEPOWER TO CLIMB STAIRS

To lift 550 pounds one foot in one second requires what is known as one horsepower. Similarly, a horsepower is able to raise twice that weight one foot in twice the time, or one-half foot in just that time. Moreover, it can raise half 550 pounds one foot in half a second, or two feet in a second, and so on. Therefore, when we lift one-fourth of that weight, 137½ pounds, four feet in one second, we are exerting one horsepower.

Accordingly, when a person who weighs 137½ pounds runs upstairs at the rate of four feet a second, he is exerting the equivalent of one horsepower. For a man weighing twice that much, 275 pounds, it would be necessary to climb at the rate of only two feet per second to exert a horsepower. It is possible to do much more.

As a matter of fact, a horse often exerts many times one horsepower of energy. The average horse can draw a wagon up a hill where a ten-horsepower engine with the same load would fail. A horsepower does not represent the greatest momentary strength of the average horse, but is a measure of the power which he can exert continuously.

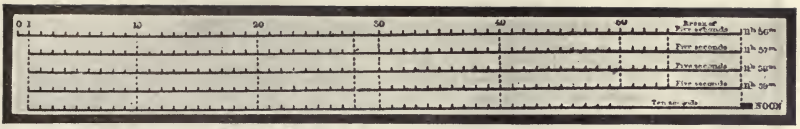
CATCHING FISH WITH ELECTRIC LIGHTS

Three White River fishermen of Mount Vernon, Ill., have a plan which has been very helpful to them this winter in catching fish.

They constructed an equipment for lighting the water under the ice and which attracted hundreds of fish to the place. These eagerly bit at the bait dropped to them on hooks. The catches were unusually large.

The arrangement for lighting the water consisted of eight dry cells, to which an electric light was attached and dropped into the water. The wire was heavily insulated to prevent the leakage of the current.

A conservative estimate places the total number of electric lighting companies serving the public in this country at five thousand or more.



Diagrammatic Illustration of How the Time Signals Are Sent Out by the Transmitting Clock at the Washington Observatory.

WHEN IT IS NOON AT WASHINGTON

EVERY day exactly at noon a copper time ball, three feet in diameter, on the roof of the State, War and Navy Building at Washington, D. C., falls from the top of a ten-foot pole into a receiving cup, where the air forming a cushion permits it to land almost without noise. About five minutes before noon an employee of the Navy Department hoists the ball by hand. At 11:55 the transmitting clock at the United States Naval Observatory, several miles distant, which, between 11:30 and 12 o'clock, is accurately adjusted to indicate the correct time, begins to beat the seconds automatically, leaving out the 29, 55, 56, 57, 58 and 59th seconds until the last minute before noon, when the 29 and 50 to 59th seconds are omitted. The beating of these seconds is indicated by a distinct click at the ball. During the last 10-second interval, when there is no signal passing over the wire, switches in the State, War and Navy building are thrown in, connecting the mechanism which automatically drops the time ball. When the next beat, indicating exact noon, passes over the wire, the releasing lever allows the ball to drop. The accompanying diagram shows the scheme followed in sending out signals.

The Time Ball On the State, War and Navy Building In Washington, D. C.

These time signals sent out by the United States Naval Observatory are automatically repeated by the Naval Radio Station at Arlington, Va., across the Potomac from Washington. Anyone having the proper wireless receiving equipment, which is not expensive, may receive them.

INCREASING USE OF ELECTRIC DRIERS IN SHINING SHOES

Bootblacks are coming to appreciate the use of electric driers more and more. It is especially in the shining of russet shoes that the electric drier is most appreciated, for the usual method of drying the shoes with a palm leaf fan or newspaper is a long and tedious process. Many electric driers are made especially for shoe shining purposes and are fitted with a supporting arm that serves to hold the drier to the foot rest. While one shoe is being dried, the bootblack can be working on the other shoe.

The Government built more than two thousand miles of trail and three thousand miles of telephone line on the national forests in 1914.

In Order to Carry On the Work of Erecting a Building During the Winter, a Cleveland Contractor Used a Large Tent.

ERECTING A BUILDING UNDER A TENT

What is considered a novelty in the building line was the erection of a factory building under a tent. This was rendered necessary because of the intense cold prevailing at the time.

When fire destroyed a part of the factory of an electrical manufacturing company of Cleveland, Ohio, it became necessary for the management to provide at once facilities at the new plant then under construction in an outlying district. Three buildings had already been completed at the new location, including the power plant, the smokestack of which is seen protruding through the tent in the accompanying illustration.

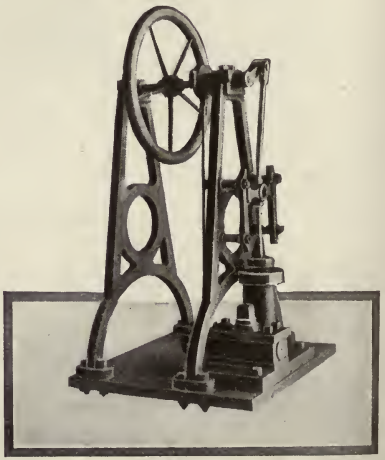
The contract for the new building called for the building to be ready for occupancy not later than February 1, and required the contractor to guarantee the masonry against the effects of freezing. Excavation for foundations was begun January 10, and on January 27 the building was turned over to the owners. Here is how this remarkable feat was accomplished:

The contractor paid $1,000 for the use of a tent for thirty days, with the understanding that the company was to raise it when requested and maintain it in the proper condition. While the lower 10-foot section of the walls was being laid, the sidewalls of the tent reached the ground. The tent was then raised to permit the building to be finished. A workshop was provided for carpenters and other mechanics under the part of the tent that was not raised, shown at the left in the view. Steam was brought to the building under construction from the power plant and carried through numerous pipes placed against the walls of the building on the inside.

At the time the photograph reproduced on this page was taken, the temperature outside the tent was 10 degrees below zero. Not only did the tent prevent any possible damage to the masonry through freezing, but it also served to protect the workmen from the cold and thus made their task a far more pleasant one.

TOY ENGINE 80 YEARS OLD

An ingenious toy steam engine, designed along lines now obsolete, shows the kind of work that boys of 16 could



A Toy Steam Engine Constructed Eighty Years Ago With Crude Tools.

do eighty years ago. The boy was an apprentice in a Boston machine shop and built the engine unassisted during his spare moments. It was exhibited at the Mechanics' Fair in 1837, and was awarded a diploma and a silver medal.

The engine is of the old "steeple" type, and is about 14 inches high. The fly-wheel is a mechanical puzzle, as it is built up of wrought iron with tapering spokes which fit into a weedless rim. It is probable that the spokes were bent before they were put in place and straightened afterwards.

The piston, cylinder heads, valve glands, steam chest, etc., have no packing but were ground carefully so that they were steam-tight. The threads cut on the bolts are of an unusual pitch, the use of which was discontinued by machinists many years ago. All of the work of the engine was done on a 16-inch lathe, of the crude type used in those days

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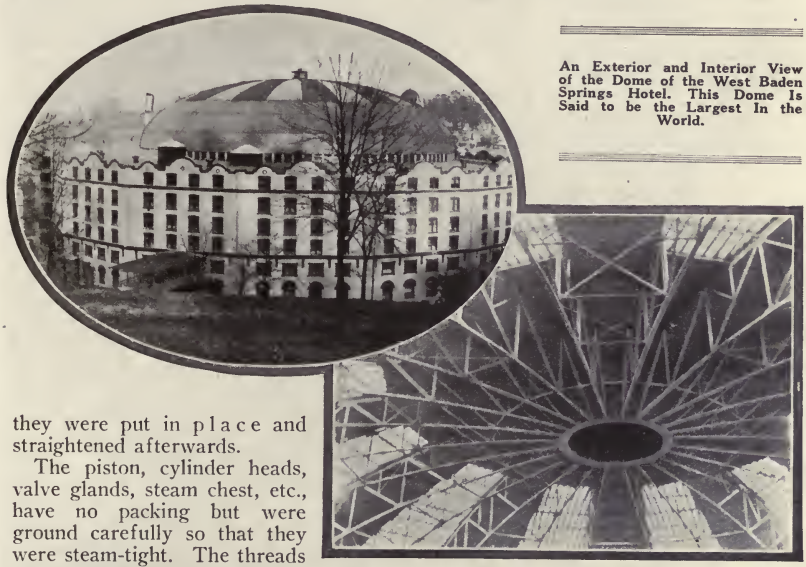
From good authority it is gathered that Germany's two great electrical manufacturers, the Allgemeine Gesellschaft and the Siemens & Halske Company did a gross business last year of about $170,000,000. Much of the goods produced by these companies was purchased by European buyers.

THE LARGEST DOME IN THE WORLD

What is said to be the largest dome in the world forms part of the West Baden Springs hotel in Indiana, surpassing those of Petrograd (St. Petersburg), Russia, and Washington, D. C.

The floor space of the hotel covered over by the dome is 200 feet in diameter and contains 62,832 square feet. The dome is constructed entirely of steel and glass, and has no central supports. Its construction was such a large undertaking that only one contractor bid on it.



An Exterior and Interior View of the Dome of the West Baden Springs Hotel. This Dome Is Said to be the Largest In the World.

So great is the vibration of the building that the dome is held in place securely by putting the lower ends of the roof trusses in shoes and on rollers. By going to the top floor of the hotel on a windy day, one can feel the movement of the rollers inside the shoes, which will show how inadvisable it would have been to permanently fasten the dome.

If you enjoy THE WORLD'S ADVANCE, tell others; if not, write us and state your reasons.

ELECTRIC INCUBATOR HATCHES GERMS

Great strides have been made in the scientific study of bacteria during the past few years through the culture of bacilli in incubators. Microbes in large numbers lend themselves to microscopic study a great deal more readily than do small, unhealthy groups.

Bacteria incubators heated by gas have been employed in the majority of laboratories, but the recent invention of an electrically heated incubator, having several important advantages, will probably displace the old type entirely.

An Electrically Heated Incubator for the Culture of Bacilli. The Heat Is Automatically Maintained at Any Desired Temperature.

The new incubator was brought out in a laboratory in Salt Lake City. Its chief advantage is a heating arrangement which maintains the temperature at a constant point. Electric heating coils are placed in the top of the incubator, and the temperature regulated by a thermostat. When the temperature varies from a given point, the thermostat moves a delicately balanced lever arm which increases or decreases the current.

A variation of one-tenth of a degree will affect the thermostat and cause the circuits to be changed until the correct temperature is again reached.

The incubator consists of a double-walled box with an air space between the walls. The interior can be viewed by means of a miniature electric lamp which is controlled by a small button. The current consumption of the electric incubator is about 25 watts per hour.

FIFTH BIENNIAL ELECTRICAL SHOW

On April 8, 9 and 10 the fifth biennial electrical show will be held at the University of Illinois. This biennial event is under the auspices of the Electrical Engineering Society of the College of Engineering. The electrical shows given in the past have all been the events of the year, and this year the show promises to outlive its motto, "Bigger and Better." Twenty-five thousand square feet of floor space are available, and three-fourths of this was assigned by March 1. The electrical manufacturers are giving their unqualified support, and over fifty concerns will be represented by exhibits and each exhibit will be fully explained by capable men. The remaining booths will display local and student exhibits. Among the students' exhibits are electrical freaks of all kinds. Also an electrical fountain, café with a cabaret, and miniature Panama Canal will be the last words in artistic and interesting exhibits.

A conservative estimate of attendance based on past records has been set at eight thousand. With each admission the management will distribute free a beautiful forty-page souvenir program well worth keeping.

The admission price will be correspondingly low as the quality of exhibits will be high. Such a combination assures the hearty support of the public, and as a result, the success of the show is assured.

STRIKING FEATURES OF MODERN WARFARE

A French lookout in an advanced position along the French line of trenches. This one-man trench is connected to those in the rear by a passageway.

A bridge blown up by the Germans during a recent retreat in France.

A French fourteen-inch field piece recently turned out by the Creusot Works and now on the firing line. These pieces are being made in large numbers and are intended to reply to the German heavy artillery.

Remarkable view of German and Austrian soldiers intrenched in Galicia. Here may be seen the wonderful system of intrenchments necessitated by modern warfare; the trenches being dug one in back of the other and connected by cross trenches.

Photos. Copyrighted International News Service.

THIS remarkable view of the German battleship "Bluecher," just after being torpedoed by a British destroyer during the North Sea naval battle, was photographed by an officer on board the "Arethusa." The crew of this ill-fated battleship that was battered by the gun fire of the British squadron and afterwards sent to the bottom by two torpedoes, may be seen clinging to the up-turned side of the hull.

Photo. Copyrighted International News Service.

THE PANAMA-PACIFIC EXPOSITION AT NIGHT

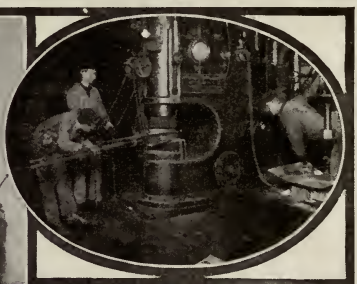
A nocturnal view of the entrance to the Court of Flowers, with numerous searchlights playing on the statues adorning the buildings. The still waters of the lagoon in the foreground act as a perfect mirror, adding further beauty to the illumination effect.

The Horticultural Building is one of the most handsome of the many structures on the Exposition grounds. It is surmounted by a glass-covered dome, on top of which is a bowl of flowers in full bloom. The bowl measures over one hundred feet in diameter.

An idea of the crowds attending the Exposition may be gained from this view, which has been takcn from the Tower of Jewels, looking towards the main entrance to the grounds. In the background is seen the Fountain of Energy.

Photos. by Rockwell Feature Service.

REPAIR SHIP "VESTAL" OF THE U. S. NAVY



The United States repair ship "Vestal," which is said to be the best equipped vessel of its kind in the world. It has a complement of two hundred first-class sailor-mechanics and accompanies the Atlantic Fleet on all long cruises.

In the Upper View: A corner of the forging room on board the repair ship. Below: Repairing the range finders of the Battleship "Georgia," on the deck of the "Vestal."

Above: Electricians at work in the electrical shop on board the "Vestal." At the right: A scene in the foundry room, showing the men at work pouring molten metal into a mould.

Photos. Copyrighted International News Service.

VIEWS OF TURKISH CITIES NOW BEING ATTACKED

A panoramic view of the Turkish city of Smyrna in Asia Minor, overlooking the Aegean Sea. Simultaneously with the bombardment of the Dardanelle fortifications, this city is being attacked by another fleet of the Allied powers.

A view of the city of Constantinople and a bridge that joins the European and Asiatic portion of the metropolis. Constantinople, the capital of Turkey, is the goal of the Allied fleet that is bombarding the Dardanelle defenses.

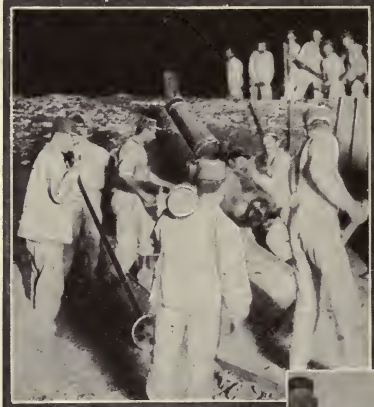
A scene along the waterfront of Constantinople. This city has a population of about one and a quarter million people. The waterways leading to it are strongly fortified and mined, and the task before the attacking fleets is a colossal one.

Photos. Copyrighted International News Service.

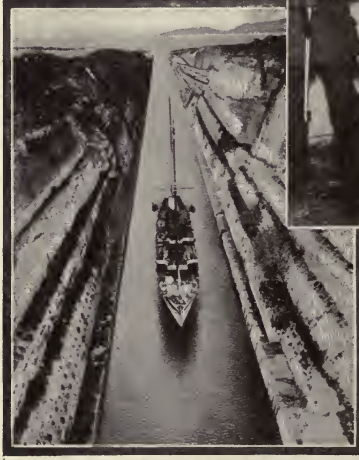
GLIMPSES OF THE WAR-RIDDEN EUROPEAN COUNTRIES

A statue crowning a church in a Belgian city was struck by a German shell yet remained partly suspended in mid-air. The inhabitants of the stricken city regard the incident as a miracle, since the statue has a highly religous significance.

A flashlight view of a French battery in action during a nocturnal engagement.



A German field telephone central near Warsaw, Poland.



Sir Thomas Lipton's steam yacht, the "Erin," passing through the Corinth Canal in Greece on its way to Servia, with Red Cross nurses and doctors. Servia has suffered heavily in the European war, and before the coming of this aid the country was badly in need of medical supplies.

Photos. Copyrighted International News Service.

FROM SNOW BOUND POLAND TO EGYPTIAN DESERTS

A German dentist treating the teeth of a soldier in the trenches in Russian Poland during a lull in the fighting.

One of the French biplanes that took part in the recent bomb-dropping raids along the Belgian coast.

A group of Uhlans shooting from saddles at their Russian foes in Poland. Their lances are temporarily stuck in the ground while they are using their rifles.

An Australian camp hospital in Egypt, not far away from the pyramids. The tent contains fifteen beds, all of which were occupied at the time the photograph was taken.

A typical winter scene of a battlefield in northern France at the present time. In the snow may be seen the bodies of dead horses.

Photos. Copyrighted International News Service.

HERE AND THERE WITH THE FIGHTING MEN

Australian artillery in Egypt returning to camp after a Battle.

According to tradition, this historic column marks the life of the Turkish government. The Turks believe that when it falls, through any cause, the Turkish government will also crumble.

A French Chasseurs Alpine climbing the side of a steep hill.

German soldiers reading official bulletins that have been tacked on the trunk of the tree. These bulletins are said to contain the news from all parts of the world and are published by the military authorities.

Photos, Copyrighted International News Service.

BRITISH SUBMARINES; FRENCH AND DUTCH SOLDIERS

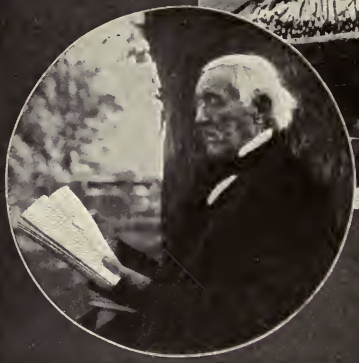
A fleet of British submarines at Gosport, England.

On the alert in the French trenches: Soldiers in their trenches during a spirited engagement on the Argonne front. It will be noted that every man is keenly alert and interested in what is taking place in front of his position.

An observation tower used by the Dutch artillery. This view was taken during the recent manoeuvers of the Dutch army on the Belgian and German frontiers.

Photos. Copyrighted International News Service.

With the passing away of street vendors, Paris officials are making phonograph records of their cries.



Alba Honeywell, who sold the first copy of "Uncle Tom's Cabin" in 1852. He is now 93 years old, yet is active.

One of the oddest catches on record in southern California is the weird looking sea monster shown here. It is a hammer-head shark.

A photographer recently succeeded in printing a photograph of President Wilson on an apple. The film negative was glued to the apple while it was still green and left for 3 weeks.

CLEANING CATERPILLARS FROM RAILROAD TRACKS

An ingenious method was recently used to clear the caterpillars that swarmed over a railroad right-of-way in such vast numbers as to seriously impede traffic.

The trouble occurred in the lumber regions of northern California, which are served by the McCloud River Railroad, and the pest developed into a positive danger to traffic. Besides, the caterpillars cleaned out everything green from the countryside and made life uncomfortable for the men in the lumber camps. The countless millions of crawlers seemed to find the rails a very convenient track, for they would follow them until the passing of a train would crush them into a slippery mass. Of course, this made it almost impossible for the locomotive to proceed with safety, and the first methods of combatting the caterpillars were quite ineffectual. Cresol was sprinkled over the tracks and ties, but the chemical seemed to please the insects and they came in greater numbers than ever; sand on the rails did no good, and the expedient of stationing a couple of men on the cowcatcher to sweep off the pests, merely resulted in crushing the soft bodies. The plan of digging ditches had been tried out with success about the lumber camps, as the steep sides of a shallow trench were an effective check, but that would have been exceedingly costly for many miles of right-of-way, and would be a slow method of getting results.

The solution to the difficulty was found when Master Mechanic John Kennedy attached a little device of his own to a locomotive and it worked like a charm. Pipes were connected to the boiler and extended to a point ahead of the cowcatcher close to each rail. Live steam was shot through the pipes as required, and the caterpillars were blown far from the rails and killed by the heat, leaving the tracks clean for traffic. The device is simple and cheap in construction, but it saved thousands of dollars in ditching, and possibly saved trains from accidents on the slippery tracks.

The Operation of Lumber Trains in Northern California Was Practically Checked by Millions of Caterpillars Crawling Over the Rails and Rendering them Slippery.

Caterpillars that Accumulated in Great Numbers on the Rails Were Cleared by Steam Blown Out of the Two Pipes Extending Beyond the Pilot of the Engine.

U-SHAPED PIPE OVERCOMES EXPANSION AND CONTRACTION

A simple method for taking up the expansion and contraction in a long pipe line for steam is in use at an Arizona mine. A large U-shaped bend is made in the pipe, and this is supported by iron posts which are connected with the pipe

Expansion and Contraction, as Well as Vibration, May be Taken Care of by a Loop in the Piping.

in such a way as to allow the pipe to move freely in contracting and expanding. This method also reduces the vibration, which is very hard on the pipe joints and in time causes leakage.

Another system consists in bending the pipe in a large circle, which has an advantage over the U-shaped bend in needing only one support.

EXPERT WORK IN LOCOMOTIVE MODEL

What is probably the most complete miniature model of the latest Atlantic type locomotive in the world has been constructed by a Boston stationary engineer.

The model, which is 44 inches long and weighs 80 pounds, rests on a 3½-inch gauge track and is capable of attaining a speed of nearly five miles per hour. The chief feature of the model is the complete equipment of air brakes and pumps, something that has never before been attempted in model locomotive building. Many locomotive engineers contended that such a small air-pumping equipment could not be built, but after several attempts the constructor succeeded in making an exact model of large pumps capable of pumping 12 pounds of air. It is 3½ inches high and has a cylinder 13/16ths of an inch in diameter with a ¾-inch stroke. The equipment of automatic couplers and leaf springs, equalized in the large engines, are the other features of this exceptional model.

The boiler of the engine carries 40 pounds of steam to the square inch with charcoal as the fuel. It has 24 square inches of grate surface and contains twenty ⅜-inch brass tubes each 12 inches long, making a total heating surface of about 2½ square feet. The steam cylinder of the model is 1¼ by 1½ inches in size with a bore of 15/16ths of an inch and a stroke of 1¼ inches.

CURIOUS STREET CAR FOR TOURISTS

A highly embellished street car is offered by an electric traction company of Montreal, Canada, for the entertainment of tourists to that city.

The seats are arranged step-wise, and around them passes a brightly gilded railing. Across the top of the car, brilliant electric arches are placed, which herald the tourists' approach for a long distance.

The seats are not unlike those of a theatre, the rows being placed one higher than the other to permit unobstructed view to passengers.

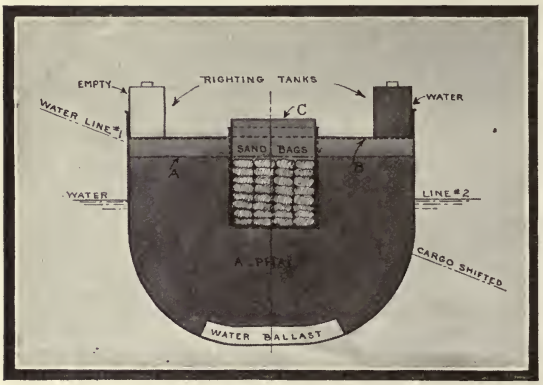
Tourists in Montreal Can Make a Sight-Seeing Trip About the City in a Special Street Car.

THE dread of a shifting cargo is one that is second only to the peril of fire or a damaged hull below the water line. The problem of handling the ship in such an emergency is one worthy of the keenest thought of the brightest mind on board ship. In this article the author relates in detail how a shifting cargo of asphalt was handled with the result that not only was the ship brought safely to port, but the entire cargo was saved as well.

NOT many months ago the following brief notice appeared in the daily press: "The steam collier *Turret Hill* has sunk owing to the shifting of her cargo. The chief engineer, who was picked up by a passing steamship, said that the vessel turned turtle, heeling over so rapidly that there was no chance to launch the boats."

Next to the peril of fire or the menace of a damaged hull below waterline, seamen have a deep dread of a shifting cargo, and for good reason, as the foregoing news item makes plain. The story we have to tell is about another vessel that survived a kindred hazard, even though she rolled over on one side so far that the thundering waves dumped tons of blue water upon her defenseless deck and came precious near to capsizing her.

The Danish steamer *Berlin,* loaded with asphalt, set out from Trinidad for New York under seemingly promising conditions. She circled about the West Indies and then turned northward along our coast in the helpful sweep of the Gulf Stream. Shortly after this she encountered a severe gale that raged for days. This did not disturb her stolid Scandinavian crew, and the steamer held her own although her engines were hard put to it and her boilers over greedy for the dwindling coal in her bunkers. Days slipped by with only moderate progress, and the supplies of food and



Showing How a Plunger Was Let Down Into the Shifting Cargo of Asphalt to Raise the Latter Up to the Level of the Deck. A Shows Level of the Fluid Asphalt After the Vessel was Righted; B, the level of the Asphalt After the Steadying Tank C Was Loaded and Sunk Into the Cargo Hatch.

fuel wasted while the destination remained still hundreds of miles off.

However, there was no immediate cause for alarm and the *Berlin* worked her way north of Bermuda without mishap. Then the unexpected happened. Three great seas hit her in rapid succession, shaking her violently from stem to stern and rolling her lee scuppers well under water. The last wave flooded her deck, worked its way back into the ocean with fearful slowness, and left the steamer permanently heeled over even after the water had escaped! What had happened? Why, her cargo had shifted, and put the ship in a predicament that promised to make it easy for her to turn turtle if three more seas of like magnitude should assail her. It was a situation calling for the promptest kind of action and the best of seamanship. But why had the cargo shifted? It had seemed stable enough when dumped into the hold.

Owing to the head winds of the storm, the *Berlin* had lingered for days in the warm waters of the Gulf Stream, and that heat had been sufficient to penetrate into the entire mass of the crude asphalt and to make it semi-fluid. When those three seas hit the vessel they set the cargo surging, and this weight was enough to tear from its fastenings at one end the metal bulkhead that divided the hold into two lengthwise compartments. Naturally, the stuff flowed to the lower side of the *Berlin* as she heeled under the attack of those giant waves, but could not return to the normal position because the loosened bulkhead, like an opened door, swung to again when the ship lurched to right herself — the weight of the plastic cargo shutting the passage by which it had entered from the adjoining compartment.

By dint of desperate work and twenty-four hours of unceasing toil, the captain and his crew managed to get the upper edge of the ruptured partition back into place and secured by means of heavy wire rope. During that period of awful suspense, the skipper's wife, also a Dane, steered the ship without relief, and so exposed was her station that it was necessary to lash her to the wheel. But the remedy to the bulkhead was only a partial one, because it was impossible to fasten the lower edge which continued to flap like a valve as the ship rolled from side to side. This movement was akin to the action of a pump and sufficient to raise the asphalt in one half of the hold to a level four feet higher than that in the flanking compartment. Thus, hour by hour, increased the *Berlin's* list.

To offset this, the engineer managed to shift to the bunkers on the high side forty tons of coal, and in this manner and for a time he helped to offset the increasing heel. But, unfortunately, that coal had to be burned, and there was just enough of it to get the freighter into the nearest American port—the little harbor lying behind the sheltering sandy arm of Cape Lookout, North Carolina. The ship did not get there an hour too soon as it was, and for more than a day there had not been an ounce of food aboard for the exhausted crew. But once there, the question of getting her thence to New

York was something to be settled by the underwriters and the vessel's agent. Here is where the resourceful genius of an ex-naval officer saved the day and, incidentally, showed how a minimum of effort would put the vessel on an even keel and make it safe for her to proceed under her own steam to her destination. This emphasizes the advantage of a technical training and the flexibility of mathematics when mastered and properly applied.

The salvage company was asked to remove from the *Berlin* a thousand tons of that troublesome asphaltum. This meant digging the stuff out and the employing of men especially trained in handling this sticky material. At best, this might have called for weeks of work. These thousand tons were to be placed in another vessel which was to be towed

In the Oval: Loading the Sand Bag Ballast On a Barge In Order to Transport It to the Steamer. Below: How the Righting Tanks Were Built Quickly Upon the Deck of the Steamer "Berlin."

back to New York. As a business proposition it was not an inviting one, and the expert of the wrecking company wondered if some other solution were not possible, and for aid in his dilemma he turned to Mr. R. H. Robinson who, before he resigned from the navy, had made himself famous by designing the first of our modern dreadnoughts.

Mr. Robinson spent about ten minutes in figuring and then declared it would not be necessary to remove a pound of the *Berlin's* cargo in order to restore her to the upright. By placing 130-odd tons of water ballast on the high side of the open deck, in a long tank to be quickly built of wood, he declared that this weight would be ample to get the ship back on an even keel despite the bulk of the three thousand tons of asphalt in her hold. A little more mathematics, and it was made plain that the needful tank could be built and made ready to hold water inside of four days. So far, the problem of restoring the equilibrium of the *Berlin* was solved, but the ship would have to make the rest of her run in the open sea, and what would happen if she encountered another storm? What was to keep the asphalt from shifting again? The stuff did not entirely fill the hold. The cargo space was like a partly-filled bottle.

Mr. Robinson had disposed of one difficulty and he was ready with an answer for this new one. He knew that he could steady the asphalt only by making it fill the entire hold, but how was he to raise its level without dumping something in to crowd the stuff upward? That something would have to be heavy enough to sink and might add complexity to the situation when the bitumen was finally removed in New York. The hold, because of the overlying steel deck, was virtually a great metallic flask, and the neck was the deep-throated cargo hatch. For this opening, Mr. Robinson proposed a rectangular tank of wood which could be rapidly built and so fashioned that it would be a snug fit yet free to move up and down like a pump plunger. You see what is coming, don't you?

By loading this tank with bags of sand it was so weighted that it would sink into the asphaltum to just the required depth to bring the level of the latter up against the underside of the covering deck. In this manner the cargo was steadied just like the contents of a filled bottle. But it would not do to transfer this pressure to the underside of the deck with all its force if the freighter should roll in a heavy sea. It was necessary to have a safety valve, so to speak, to absorb or to permit this pressure to expend itself otherwise and harmlessly. It was for this reason that the plunger or "displacing tank" was free to move up and down; the upward movement representing the harmful energy that otherwise would possibly rupture the confining deck and expose the vessel to the danger of inundation and, perhaps, certain sinking.

All of this work was done at Cape Lookout in three days after the little salvage steamer *Forward* arrived there. The only thing that threatened to cause a hitch was the lack of available sand bags, and there were not enough of these to be had in that part of North Carolina within a radius of hundreds of miles. The salvors wanted them and wanted them quickly. They were called for by wireless, and inside of three hours were on their way to Beaufort—the nearest port just inside of Cape Lookout. But how do you think they were dispatched? This shows us another side of the necessary resourcefulness of the wrecking business.

The bags were "personally conducted" to save time—expressing would have been too slow. And the gunny sacks were packed in a number of big trunks bought for the purpose. These were not of the latest make, but they had a dazzling amount of shining metal by way of external finish. Their number suggested a honeymoon. While they were on their way, a message was sent to Goldsboro from Beaufort announcing that a belated groom was coming down with his bride's trousseau—the bride being supposedly at Beaufort. The station master was asked to relay the trunks at the transfer point with all speed and was thanked in advance for his courtesy. When the resplendent baggage reached Beaufort in good time it was decorated with streamers of white ribbon at every point where bows could be fastened!

The station master and his friends at Goldsboro had thus responded with Southern gallantry. This good will towards the imagined bride saved precious time in getting the freighter ready for sea, but it was probably well that

York until she returned to her home port convoying the *Berlin,* was a matter of a trifle over ten days. The freighter made the trip under her own steam. But for the readiness of Mr. Robinson and his training in the navy, the helping of

Above: "The Last Wave Flooded Her Deck, Worked Its Way Back Into the Ocean With Fearful Slowness and Left the Steamer Permanently Heeled Over Even After the Water Had Escaped." In the Oval: Testing the Little Pump That Controlled the Water In the Righting Tanks.

the ship left before the railroad people got wind of the true nature of that fictitious trousseau!

Instead of taking weeks and spending a great deal of money in the undertaking, the entire work, from the time the salvage steamer headed south from New

the listed cargo craft would have been a routine salvage job and a long one. As it was, thanks to his resourcefulness, a novel way was evolved for meeting a similar problem in the future. Time always has meant money in the hustling world of business, and time saved is

money saved now more than ever. The calling of the wrecker in the past has been largely a rough-and-ready enterprise with not overmuch of science or technical skill in its ways of working. What Mr. Robinson accomplished shows how splendid is the opportunity for the technically trained man and the engineer in a field hitherto somewhat neglected, to apply their knowledge.

QUARTER OF A CENTURY PROGRESS IN BRIDGE DESIGN

The accompanying illustration is of particular interest in that it shows the progress that has been made in bridge building during the last twenty-five years.

Each of the bridges shown carries two tracks of the New York Central Railroad, formerly the Lake Shore, over the Cattaraugus Creek, near Irvington, N. Y. When the smaller bridge was built in 1889 it was thought ample in strength to take care of the traffic for many years. It would not be in service today but for the fact that bridge engineers twenty-five years ago put more than twice as much steel in the bridge to carry each ton than they do today. The larger bridge, built about two decades after, differs noticeably from the smaller structure in stiffness. This is due as much to its riveted connections as to its heavier members. In the old bridge, the joints or connections are made up of eye-bars joined together with pins, considered a good practice a generation ago. The very fast traffic of today requires rigid, well-detailed connections.

A Graphic Illustration of the Changes Wrought During a Period of Twenty-Five Years In the Design of Bridges.

The old bridge is 24 feet 6 inches high and 29 feet wide between truss centers. The new bridge is 37 feet high, or half again as high as the old one, and 31 feet wide. The span of either bridge is the same.

SUIT CASE AS AN AUTOMATIC THIEF

Recently a man was arrested at the San Diego Exposition on suspicion, in connection with the disappearance of many tools from the buildings and concessions. He had been observed about the buildings frequently, with a suit case in his hand, but no one remembered having seen him pick up any tools or open the suit case. Upon searching it was found that he had quite a collection of tools in the suitcase, which he had gathered during the afternoon. The method was a very clever one, as he had gone to a large amount of trouble and expense to make an automatic thief out of his suit case. He had cut a sort of trap door in the bottom of the case, and had arranged a claw which opened and then closed about the tools and other objects, lifting them up into the interior of the suit case. These claws were operated by a spring connected with the handle of the case. Walking up to the place where a tool was lying on the ground or floor, he innocently set the suit case down on top of the tool, and his action naturally enough attracted no curiosity or suspicion. Then when he picked the case up he pressed the spring in the handle and the tool was seized and placed inside, after which he walked safely away.

Introducing Scientific Apparatus in Photoplay

THEODORE WHARTON, collaborating with his brother Leopold in the production of "The Exploits of Elaine," has some very interesting things to say of the scientific apparatus used in the different episodes. Mr. Wharton, in the first place, emphasizes the fact that the various remarkable mechanisms shown are not the product of the studio workshop, but the genuine article, in one instance at least the only one ever produced and tremendously costly.

"For instance," says Mr. Wharton, "we are now using in the making of the eleventh episode an apparatus called the 'telegraphone,' which is the only one ever made, and which represents the expenditure of millions of dollars though the actual mechanical cost would not exceed two or three thousand. The large sum first mentioned has been expended in the experiments which have been brought to a successful conclusion in the machine, which has been kindly loaned to us for a few days by the manufacturers. Briefly, this is what the apparatus will do: You call up a man in Seattle on the 'long distance' from New York. He is away, but yet you may speak into the 'phone what you wish to tell him, and on his return by placing the receiver to his ear he will get your message and in your own voice, too.

"Again, in the tenth episode, we use the 'electric resuscitator' which recently was used for the first time on a girl who had been pronounced dead by a number of able physicians, and yet was brought back to life a half hour later by this remarkable device. This machine, which is truly almost supernatural in its powers, was invented by Dr. Leduc of the Nantes Ecole de Médécine in France. The apparatus is so new and such a rarity that we found it very difficult to secure one for our picture.

"Another new and remarkable invention we have used is the 'vocaphone,' which projects the voice of the user of it so that it may be heard a long distance from the receiver at the other end.

"No, we are not faking any scientific apparatus in 'The Exploits of Elaine.' We don't have to. The inventors of these different remarkable machines voluntarily offer us the use of their devices, feeling that the use of them in a motion picture of the tremendous circulation of this film cannot help but bring new and valuable publicity."

BIG SERIAL FEATURE IS COMPLETED

The last instalment of the "Master Key" serial produced under the direction of Robert Leonard, the Rex director, has recently been completed.

Owing to the inclemency of the weather along the southern Californian coast, which has meant the loss of so

much valuable time to the motion picture people, the company has been working day and night in the indoor studio at Universal City in an effort to keep up with their releases. On several occasions, tons of dirt have been hauled in and dumped upon the floor of the interior studio that a counterfeit of the outdoors might be made inside within range of the big electric lamps. This has, of course, meant great loss of time with the result that the company has had to work as many as seventy-four hours at one stretch without stopping except for meals.

CONVALESCENT SOLDIERS AS MOTION PICTURE ACTORS.

One instance of how European motion picture producers are utilizing the present war in their films is presented in the accompanying illustration. The two men seen above the trench in the view are both British soldiers who were wounded in the battle of Mons, Belgium. They are spending their time during convalescence by taking part in the production of a war film in a London suburb.

These soldiers make excellent actors in war photoplays, for they lend to the picture a realistic and accurate atmosphere that is so difficult to obtain with ordinary actors.

FIFTY MOVING PICTURE SHOWS GIVEN DAILY AT THE EXPOSITION.

To illustrate great industries of many kinds, forty to fifty motion picture shows are being given every day in the various exhibit palaces of the Panama Pacific Exposition. Among these the Government uses the cinema to illustrate educational methods, the American Telephone and Telegraph Company to show how calls are handled, and many manufacturing processes are also shown.

Photo. Janet M. Cummings.

British Soldiers Who Have Been Wounded on European Battlefields, Taking Part in a Photoplay While Convalescing.

THE factories of Pathé Freres produce in round numbers 2,000 miles of finished film daily. In fifteen years the profits of the company have increased more than 1,000 per cent. Painstaking thoroughness has blazed the trail of the Pathé rooster to the remotest parts of the world.

WHEN the war broke out, nearly every workman in the Vincennes factory of Pathé Freres was conscripted for service in the French Army. Women operatives were hastily recruited for the vacant places, and put through a rapid-fire course of training; whereupon the true nervous passion of French temperament broke to the surface, the rippling product was forged out, the reels boxed, crated and sent hustling on their way to the thousand parts of the world.

Then the Germans swooped down towards Paris from the North. Vincennes was in constant fear of destruction—of a fate like unfortunate Rheims. The thunder of the Krupps rolled out to the feverishly busy film factory where two shifts were urging the machinery at a twenty-four-hour-a-day clip. But the work was pushed unheedingly. It might have been that the few hundred women bent more comfortably over their tasks when finally the rumble of the guns tapered off to a murmur, and the invaders, driven back and back, crawled over the line again into Belgium.

There was nothing melodramatic in the bravery of these women—these *ouvrieres* —their attitude was simply one of calm patriotism. They realized that their Louis, their Jacques, their Henris were off up there fighting desperately for them; and when the thunder of the Krupps was loudest and closest, the women merely rolled up their sleeves a little higher and turned out celluloid film faster than ever.

Which Explains the Rooster

This act and this attitude are typical of the French, and would be ascribed by the French as *"avoir du culot,"* or pluckiness, as we would call it. Thereby, in addition to increasing our respect for the French people, a long-standing question is also cleared up; just what symbol is the Pathé rooster supposed to convey? The answer comes as a matter of common sense; the dapper little bird, legs astride, beak agape in a lusty crow, stands for gameness and pluckiness, not to say cocksureness.

When the Pathé rooster came over to America a great many years ago, his cocksure ardor was dampened almost to the melting point. Notwithstanding the

fact that American audiences at first were delighted with anything that moved, however imperfectly, across a screen, they very shortly began to demand something far better—a picture that told a story—not merely the insipid view, for instance, of a railroad train crawling wearily into a station.

The Pathé Brothers concentrated every energy to conjure up something—for it seemed that magic would certainly be needed—that would satisfy the exact-

all of the American Pathé films come from, offers a sharp contrast to the glamor attached to the name—and to the rooster. If you are on the alert, you glimpse as they flash past, a group of uninteresting buildings sprawled out over a fenced-in portion of meadow land equalling in area an ordinary city block. In the front is a square, red brick building, and tucked behind it in decreasing order of height are a series of wooden structures.

The Joining Room at the Bound Brook Factory. Here the Different Sections of a Photoplay are Joined Together into a Continuous Film.

Another View of the Joining Room. The Girls Engaged in This Work Become Exceedingly Dexterous Through Continuous Practice.

ing Americans. Rough and tumble comedies were the first experiment; then along came a succession of badly acted dramas and garish melodramas. Eventually the groove was found in movies which were actually made in America. Since then, the popularity of "Made in America" Pathé pictures has swept the country.

The Iron Hand Felt Here

The unobtrusiveness of the Pathé manufactory at Bound Brook, N. J., where

I do not mean to disparage the Pathé factory in any sense; French factories are consistently plain and uninteresting—but from the outside only—and the Bound Brook factory is quite typical. It has the atmosphere of France, and a large number of the people at work there are French-speaking. In fact, as I was to learn later, eight or ten French Reservists, *chasseurs à pied,* who were employed there, went to France immediately on the outbreak of the war.

The gate keeper, who guards the entrance, has hardly scraped a speaking

acquaintance with our language as yet. While I was waiting in the little guard-house by the gate for the *directeur* to put in an appearance, a bell rang sharply somewhere in the interior of the main building. Immediately, the numerous exit doors flew open, and the occupants, two or three hundred men and girls, poured out into the yard. This, I was informed, in a mixture of very bad English and very good French, was a fire drill. It is a compulsory performance and takes place at frequent intervals at Bound Brook. The system is so fine that the entire factory can be emptied in less than one minute. Several years ago a workman was lost in a bad fire and since that time an organized fire drill has been held unforewarned at weekly intervals.

With the growing adoption of the new Pathé non-burnable film, the fire hazard will be reduced to a fraction of its former importance. Just as soon as the stock of explosive film now on hand is consumed, the non-inflammable type will be used exclusively. Film is now stocked in a building isolated from the rest like a dynamite shack. It is carefully guarded against fire, and numerous signs convey to the potential offender the warning, *No Smoking!*

A Battery of Projecting Machines Operated by Women Who Inspect Finished Film Before It is Allowed to Leave the Factory. Imperfect Film Is Destroyed.

A Corner in the Perforating Room. This Room is Ordinarily Darkened, the Only Light Being from Ruby Lamps. Here the Raw Film is Perforated.

Reducing the Personal Equation

To the unpracticed eye of the visitor, the net result of a trip through any of the up-to-date moving picture manufactories is just about the same. A film must go through certain prescribed stages in its career from the blank yellow ribbon in the canister to the finished, vitalized reel crated for shipment. Although the Pathé factory is no particular exception to this rule, many of the incidents in a film's career are quite unique in themselves. For instance, the business of developing, which is carried out in most factories by a painstaking process of laboriously dipping clumsy "racks" of film in untidy tanks of solu-

tions, at Bound Brook is done by a complex machine so perfect as to almost entirely disregard the human element. It comprises, in brief, a formidable mass of slender upright glass tubes reaching almost to the ceiling of a high room, gleaming whirling cogs and chains, with here and there a flash of a slowly-moving film.

The new Pathé developing machine is a triumph. Its results are as certain as the foreknown sum of a column of figures. From start to finish the development of a film of average length consumes about forty-five minutes; 10,000 feet of finished film are turned out in an hour.

Behind a walled-in space to the right was the dark-room. "In there," explained my guide, "the films are put through the various stages of development and fixing. The first thing we do with a new film is to test it with the developers. We adjust the solutions in the cylinders through which it must run so that the results will be absolutely uniform."

He led the way up a flight of steel steps into the intricacies of the purring mechanism. All around us were the open tops of the long, slim tubes into which the endless strip of film was passing, down and down until the bottom was reached, and around a sprocket wheel from which the film turned and ascended.

"The films leave the developing and fixing cylinders in the dark-room, pass out through the little aperture in the wall, and are thoroughly washed and stained here." He indicated the nearest group of tubes in and out of which a gleaming film was slowly weaving.

"When the film is thoroughly rinsed and stained whatever color is desired, it passes through a number of glass cases in which a stream of air, slightly warmed, is circulated. By the time it emerges from the last section it is quite dry. It is wound automatically upon a reel and is then sent out to the polishing machines."

We visited a room nearby where the film is polished and buffed. Several girls were busily sewing rough cloth tufts upon belts which were attached to machines.

"We take great pains in handling films for the sake of cleanness and clearness. Projecting machines nowadays are so perfect that the slightest defect—a watermark, for instance—shows up on the screen in a way we can't afford. All of the girls who handle the film are compelled to wear cotton gloves—an order we put into effect just a few weeks ago."

The Firing Line

One of the most interesting places in the entire Bound Brook *usine* is the testing room, where the finished pictures are projected and examined for defects. A battery of a dozen moving picture projectors forms a veritable "firing line." In the "trenches"—behind each machine—a keen-eyed girl operative watches the picture as it is flashed on the white wall opposite. A copy of the New York, the first, edition of a Pathé News was being rushed through each of the dozen cameras. In one view, we saw a noted statesman, prominent in "grape juice circles," in the act of pompously descending the steps of a famous mansion in Washington. From another lens issued, in grim parade, a contingent of French soldiers en route from Paris to the front. Still another picture, from Detroit, illustrated an embarrassed Great Man, with an uneasy smile, who had done something wonderful or other for humanity.

Occasionally, a girl would stop her machine, scrutinize the image of a portion of film that she suspected of defection, and if her suspicions were confirmed, she would clip out that portion from the rest of the film.

"Every inch of the twenty-five miles of film we turn out each day is thoroughly inspected in this way," the *directeur* was saying. "Our great boast is thoroughness; it is the keynote to our organization."

Thoroughness in another sense illustrates the universality of Pathé Freres. Titles and sub-captions of films are printed not only in English but in French, Italian, Spanish and German. From the home factory at Vincennes, films go out

in nearly every language of the world—even Japanese and Chinese.

Girding the World with Celluloid

Across the Hudson River in Jersey City, the American Pathé studio is located—hardly more than fifteen minutes by subway and tube from Times Square. This closeness to New York offers a peculiar advantage to a moving picture producer—the availability of Broadway dramatic stars. As a matter of fact, a star can quite readily perform before the Pathé camera every morning, and get back to his "legitimate stage" in plenty of time for the matinee.

It is rather difficult to believe that the quiet, gray studio is really the birthplace of the world-kindling "Adventures of Pauline" and the equally thrilling "Exploits of Elaine." Yes, indeed, we saw Miss Pearl White in action! In the original, she loved and hated just as attractively as she has done on a blank screen before thousands of admiring audiences. Moreover, she is even prettier off the screen than on, and she has an engaging way of making fun of the whole business between pictures!

A Glimpse of the Activities in the Jersey City Studio, Showing the Lighting Equipment. In the View May Be Seen Several of the Leading Characters in the Famous Serial, "The Exploits of Elaine."

The serial film "The Exploits of Elaine" is being produced by Theodore Wharton and his brother Leopold. The film is of quite an unusual nature, since it introduces new scientific inventions in a thrilling manner.

Leopold Wharton, the Pathé director, who is, perhaps, not so well known as his leading lady, can, when inspired, be accurately compared with a caged lion. Unlike most directors, he does not swear

— much — and he exercises a wonderful control over his little troupe.

In a separate part of the studio building are located, besides the executive offices—for this is the brain center of the American Pathé genus—the Pathé Daily editorial rooms. These rooms have the true atmosphere of a metropolitan daily; telegraphs are clicking incessantly from all parts of the world, and reporters and camera men are continually dashing in and out. From the time the negatives come in from France, Africa, Japan—all over the earth—they do not pause an instant until they are clicking off the miles on a fast mail train to some distant exhibitor.

The Machine Shop of the Pathe Factory at Bound Brook, N. J.

Pathé camera men are stationed in all parts of the world where anything of unusual interest is likely to happen. They form the intricate network of veins which tap the news sources of the uttermost parts—and by a like system of capillary arteries, the news is disseminated over the world.

The aggregate production of the Pathé factories is 300,000 meters, or nearly 2,000 miles, of finished film per day. From 1900 to 1914, the net yield of the organization increased from 472,000 francs ($94,400) to 8,433,000 francs $1,686,000)—a growth of considerably more than 1,000 per cent.

Painstaking attention to details is partly responsible for the success of Pathé Freres—the rooster sums up the rest of the explanation in his attitude.

ELIMINATING THE SUB-TITLES IN FILMS

"Road o' Strife," the Lubin serial by Emmett Campbell Hall, release of which begins April 5, embodies a number of novel and new features, one of the most important of which is the maintenance of illusion to an extraordinary degree. This is largely accomplished by means of a new idea in captions conceived by Mr. Hall and ingeniously worked by Director John Ince.

As it is generally admitted that the caption or sub-title is the greatest crudity and most jarring defect in the photoplay, the "Road o' Strife" idea will be of paramount interest to the entire industry.

"For several years," says Mr. Hall, "I have been trying to get away from trite and banal captions. Finally it occurred to me that the key to the problem was the dialogue caption and the judicious use of screen letters and clippings, though this would necessitate the elimination of the drop-curtain caption, and entail a complete change in the established methods of photoplay construction. I have endeavored in 'Road o' Strife' to demonstrate the possibilities of my theory. In the fifteen reels composing the serial, there is but one title—'A Week Later'—which is not a speech by a character, and the single exception was for a particular purpose.

"To get the effect desired, it was necessary to devise a method whereby the words could be conveyed to the mind of

the spectator without his consciously reading them—in other words, in such manner that he would subconsciously assimilate the thought or fact to be conveyed. If we are looking at a person, and that person begins to speak, *we do not cease to see the speaker*—the eyes do not suddenly go out of business while the ears perform their offices, but just that, in effect, has been the demand made upon the picture spectator to kindly go blind to the action while his eyes perform the functions of his ears and transmit a thought to the brain.

"To maintain a proper illusion, the spectator must be tricked into unconsciously using his eyes for his ears, and to accomplish this he must still be permitted to *think* that he is devoting his attention exclusively to the action. It is accomplished with utmost simplicity and yet so effectually as to produce almost the effect of audible speech by continuing the action while the necessary caption is being shown. The caption will be read without consciousness—the method of conveying the message to the brain not being noted. This is what we have done in 'Road o' Strife,' and we believe that we have proven our theories correct. No one form has been followed—every caption has been carefully considered and brought on and taken out in accordance with its individual characteristics; some dissolve in and dissolve out, others appear abruptly and slowly fade, while still others merely flash on and instantly disappear, as a sharp, explosive 'No!' seems to do. We have undertaken to visually approximate sound effects."

Mr. Hall is entitled to no little credit for introducing this new idea. It has long been known and admitted that the prevailing caption system in photoplays was exceedingly crude and unsatisfactory.

NEW DAYLIGHT STUDIO OF THE LUBIN FORCES

The biggest artificial light studio in the country was informally opened at the Lubin ranch in Betzwood, Pa., when Director Edgar Jones recently began the making of a series of three-reel pictures there. This is the third big studio to be built at the ranch during the past few years. The new studio, which has just been completed, is equipped with every modern scientific appliance for the making of photoplays. The Lubin engineers have been working for many months on the big studio, and the system of artificial lighting has been so designed and arranged as to permit the ultimate taking of natural color motion pictures there.

Extensive improvements and additions have also been made to the laboratories at the ranch. These laboratories, declared by experts to be the best in the country, are very busy places these days, and a great deal of scientific work is being carried on there by Mr. Lubin and his corps of assistants.

MOTION PICTURES WITH A MACHINE SHOP BACKGROUND.

To secure new themes and backgrounds for motion pictures, the producing companies occasionally resort to stories that require a machine shop set-

A Scene from a Photoplay in Which an Actual Machine Shop Was Used.

ting. In the accompanying illustration is an example of such a film, the setting being that of a completely equipped machine shop. The scene is taken from the Thanhouser-Mutual film entitled "On the Brink of the Abyss," featuring Frank Farrington. The scenes in which the machinery is shown were posed in the machine shop of the Thanhouser studio at New Rochelle, N. Y.

TAKING MOTION PICTURES ON A RACING AUTOMOBILE.

In the accompanying illustration is shown how motion pictures are taken of passengers and driver on a high-speed automobile. In this instance a special wooden platform has been built in front of the car to hold the cameraman and director, as well as the camera. At the extreme right appears D. W. Griffith, the well-known director. The scene is being taken for the Majestic-Mutual film entitled, "The Mother and the Law," featuring Mae Marsh who is sitting on the floor of the automobile.

Wooden Platform Fastened to a Racing Automobile, in Order to Hold the Camera, Operator and Director.

POCKET WIRELESS SET IN A PHOTOPLAY

In the third instalment of "The Black Box," the Universal serial film that is attracting much attention at present, there is introduced a pocket wireless apparatus that is used by a detective who figures prominently throughout the story. Aside from this idea, the detective also employs a form of telephone that permits him to see persons who are talking to him over the line.

DYNAMITING A HISTORIC BRIDGE

In the presence of fully three thousand people the Lubin Company recently dynamited the historical bridge across the Chester River at Upland, Pa., as a climax for a three-reel drama entitled "On Bitter Creek," produced under the direction of Edgar Jones.

The bridge was about one hundred years old and was located opposite a colony of old houses in one of which William Penn was a frequent visitor. Of late years the bridge, through old age, had become unsafe and the township authorities decided to have it demolished and build a modern structure across the river. The Lubin Company secured permission to do the actual destroying and wrote a story around the destroying of the bridge, as well as in keeping with the character of the surrounding country.

The actual blowing up of the bridge was in itself a very thrilling climax. No one knew exactly what the old structure would do when the large quantity of dynamite stowed in it was detonated. The ten camera men intrenched themselves in and behind all forms of barricades for protection, while two motor-driven cameras were stationed close to the bridge. At the word of the director the structure was rent apart with a terrific report.

If you enjoy THE WORLD'S ADVANCE, tell others.

Another example of the extremes to which American photoplay producers will go in their endeavors to have the utmost realism in their films, is presented in the above view. Here is seen a typical street of Tangiers, a city of Morocco, erected at Universal City, California, and used for staging several of the scenes in the serial film "Terence O'Rourke."

AEROPLANE BATTLE ENACTED IN FILM

While the war-locked nations of Europe have succeeded in preventing camera men from taking battle scenes on the continent, they have not been able to check the ingenuity of the American photoplay manager in perfecting replicas of battle scenes that in some cases are so startlingly realistic as to challenge the criticism of military experts.

An aeroplane battle in the clouds, during which a woman aviator hurls a bomb and destroys the enemy's plane, is the latest of spectacular and sensational realism that the studios have attempted and which is now in course of preparation by the 101 Bison company.

The enemy is seen coming into range. The two planes exchange shots and soon a fusilade is fired from both machines. The enemy is seen just about to escape when the heroine hurls a bomb from her plane. It strikes the enemy's machine, which catches fire and drops to the ground.

It has been learned with great regret that Frank Stites, the aviator taking part in the production of this photoplay, fell to the ground in his biplane while making a scene and was killed.

HUNTING FOR A CRAFT SUITABLE FOR PHOTOPLAY

Captain Wilbert Melville, manager of the Western Lubin Company at Los Angeles, Cal., has been scouring the entire coast in his yacht, "The Lucero," in an effort to locate a schooner of especial type and design to be used for a variety of scenes in the big three-reel production which he is making. While there are numerous schooners of all classes plying up and down the Pacific coast, so par-

ticular is Captain Melville, and so desirous is he to secure one of just the right type, that he has had considerable trouble in locating one suitable to the needs of the production.

SECURING PHOTOPLAY PLOTS FROM MAGAZINES

It is not an unusual occurrence for a motion picture director or even the scenario editors to refer to mechanical magazines for ideas in producing films. Recently, Director McGill, of the New York Reliance-Mutual Company, received several suggestions for a mechanical picture he had in mind by reading a copy of MODERN MECHANICS for March. In the accompanying illustration appears Director Lawrence B. McGill sitting in the center of the group.

Director Lawrence B. McGill and His Company, Comprising the New York Reliance-Mutual Company.

THE WHITE PLAGUE DEPICTED IN FILMS

The Imp company is now at work on a three-reel film which, when released, is expected to create a sensation. The film deals with the ravages of tuberculosis and will be enacted by an all-star cast. The company plans to visit various cities in the East, where the scenes will be laid in factories which illustrate ideal sanitary conditions, and also in "sweatshops" and condemned loft buildings where the plague flourishes. The feature will be entitled "Every Town," and will be original in both theme and execution. Aside from presenting an interesting story, it will possess an educational value as well.

A large force of carpenters, mechanics and plasterers have been busy the past several days at the Lubin Western Studio erecting an Algerian village. Several of the regular dressing room buildings have been transformed into Algerian structures and a number of temporary ones built, in order to have a complete Algerian street to be used in a big Algerian feature which is to start immediately.

Los Angeles, Cal., is the hub of the motion picture industry, over 80 per cent of the American photoplays being produced in that city and its immediate vicinity.

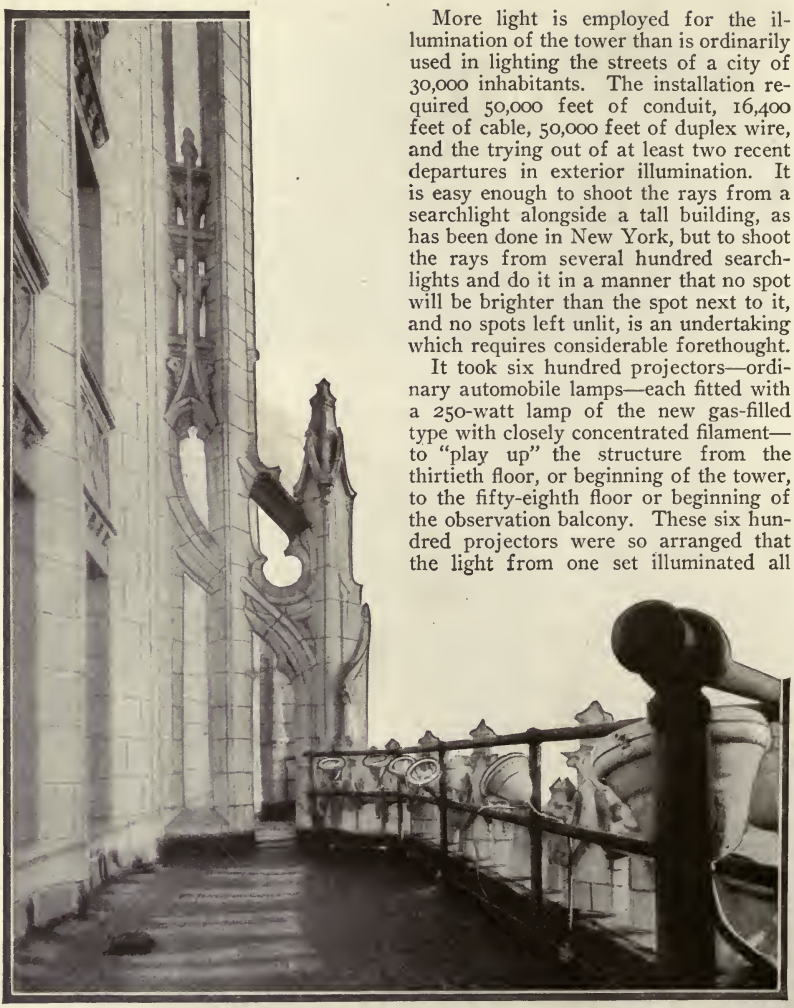
IT requires as much current to illuminate the tower of the world's tallest building as is ordinarily used in lighting the streets of a city of 30,000 inhabitants. Each night this edifice stands out against the black sky as a mighty and luminous crystal hanging from the clouds—a spectacle that leaves a permanent impression in the memory of all who witness it.

JOHN WANAMAKER and H. J. Heinz met once in a Paris hotel. After they were introduced Mr. Wanamaker remarked, "Oh, yes, you are the man who has that big sign on Broadway." This incident was very amusing to Mr. Heinz, who said it was the best evidence he had ever had of his wisdom in spending $20,000 for a single electrical display advertising the "57 varieties." He explained afterward that he had been told of that sign in seven foreign countries and twenty-six states of the Union.

Simultaneous with the blowing of whistles and the ringing of bells in New York City as a welcome to the new year, thirty floors, comprising the tower of the world's tallest building, the Woolworth Building, burst forth from the black night one giant shaft of uniform light crowned with a great scintillating jewel. When the switches were put into action throwing approximately twelve million candle power of light on the tower, the greatest permanent lighting spectacle in the world was inaugurated.

If a little piece of blue sky worth $20,000 a year rent to H. J. Heinz brings mention of it to his ears in seven foreign countries and twenty-six states, what will the advertising power of the Woolworth Building be when there is nothing in existence to approach the tower as a wonderful sight by daytime, and now an even more wonderful sight by night? All the other lighting spectacles of the metropolis fade before it. It rivets the attention and fairly burns its story into the memory of every one who glances upward in wonderment.

At first thought one might be led to believe that lighting thirty stories of masonry isn't such a mighty task after all. It all depends on the architecture, of course, and there is no office building in the world with as lavish an exterior as the Woolworth. To bring out in bold relief its hidden recesses, its balconies, its pent houses, mansard roof, observation tower and crow's nest or lantern a



These Projectors are on the Balcony of the Twenty-seventh Floor of the Woolworth Building. They Throw their Beams of Light as Far as the Forty-Third Floor of the Tower.

More light is employed for the illumination of the tower than is ordinarily used in lighting the streets of a city of 30,000 inhabitants. The installation required 50,000 feet of conduit, 16,400 feet of cable, 50,000 feet of duplex wire, and the trying out of at least two recent departures in exterior illumination. It is easy enough to shoot the rays from a searchlight alongside a tall building, as has been done in New York, but to shoot the rays from several hundred searchlights and do it in a manner that no spot will be brighter than the spot next to it, and no spots left unlit, is an undertaking which requires considerable forethought.

It took six hundred projectors—ordinary automobile lamps—each fitted with a 250-watt lamp of the new gas-filled type with closely concentrated filament—to "play up" the structure from the thirtieth floor, or beginning of the tower, to the fifty-eighth floor or beginning of the observation balcony. These six hundred projectors were so arranged that the light from one set illuminated all four sides by shooting directly upward, and light from another set of projectors shooting directly downward to fill in any spaces not "hit" by the light thrown up. It was the purpose of the engineers to

force of over forty experienced electricians not only had to face imminent danger, but they had to spread many miles of wire and do the hardest kind of figuring.

make the source of light itself invisible, and when they came to figure out a method of hiding the rays from the lamps which shot down alongside the building they had a hard task. However,

The following method of distributing the projectors was used: To light the west side of the tower a number of lights were placed on the north and south wings of the pent houses at the thirtieth

The Woolworth Building at Night, Showing the Wonderful Effect of the Electric Illumination. The Tower Is Illuminated by Six Hundred Automobile Lamps, Each Containing a 250-Watt Bulb of the Gas-Filled Type. The Lamps Are Cleverly Concealed and the Illumination of the Tower Walls Is Absolutely Uniform.

by a complicated system of screening they solved the problem, and now anyone looking upward cannot detect the source of light.

floor. These lights shot up their rays as far as the forty-third floor. From the gabled roofs at the thirtieth floor projectors were placed which illuminated

the north and south side of the tower as far as the forty-third floor. The east side of the tower had to be lighted from projectors placed on a narrow balcony opposite the twenty-seventh floor. All these projectors were employed to shoot light upward, so at the forty-third floor a similar set of projectors was placed which shot their rays downward to bring into prominence any spot not touched by the lights from the thirtieth floor.

Looking upward from the forty-third and forty-ninth floors one can see lights focused up as far as the fifty-third floor, which is the beginning of the mansard roof. On the four teurells opposite the fifty-fourth floor another series of projectors play upon the observation balcony at the fifty-eighth floor, which is just exactly 750 feet above Broadway.

The Electricians who Placed the Electric Lamps and Ran the Conduit had a Perilous Task Before them, Often Working on Uncertain Footholds Many Hundred Feet Above the Street.

The most novel feature of the installation is two stories above—the sixtieth story—which is called the crow's nest or lantern. It has been enclosed with diffusing glass and within the lantern itself, which is a very small affair and is 792 feet, one inch, above the street level. In this lamp are placed over twenty powerful lamps totaling forty-five thousand candle-power. An automatic dimmer connected with these lamps continually alters their intensity in an irregular cycle. The glass surface of the lantern forms a deep red glow no brighter than the adjacent gilded structure, and again it flares to a bright white light of fifty times this intensity.

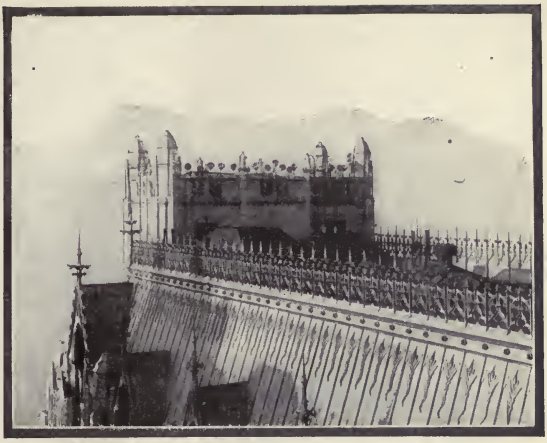
Viewed from a distance, the great tower, with the source of light hid and its thirty-floor foundation inky-black, appears as a mighty crystal hanging from the clouds. There is more light concentrated in the crow's nest alone than is used for the searchlights on some of our men-of-war. As a thing of beauty the tower lighted by night brings out in fullest splendor all the architectural detail. An afternoon's sun playing on the tower brings out its beauty to remarkable advantage, but twelve million candle-power of light directed so that its source is hidden from view accomplishes a result that even Old Sol himself has to admit is a bit out of the ordinary.

One great authority in the electric sign business expressed, as near as words can express it, the significance of the electric sign:

"It is forceful advertising when you put an isolated, distinctive bulletin before half a million people — all readers —in a single night. That is extraordinary circula-

tion. But when the announcement is so towering, so dominating, that it burns its story into the memory of each reader, its influence is so great that even circulation is secondary."

The illumination of gigantic skyscrapers by electricity is in reality nothing more than the electric sign idea on a scale of great magnitude. There is perhaps no American town of any consequence that cannot boast of several electric signs of attractive design and great advertising value, greeting the passers-by on the main thoroughfares at night. And it is especially in the smallest towns where the streets are not too well illuminated that the blaze of an electric sign is most conspicuous.



The West Side of the Woolworth Tower as Far Up as the Forty-third Floor is Lighted by Four Projectors Placed on the North and South Wings of the Pent House at the Thirtieth Floor. The South Pent House is Shown Here.

But what about building illumination. Does it pay? Evidently Mr. F. W. Woolworth thinks it does.

DAYLIGHT SIGNAL LAMPS ON ELECTRIC RAILWAYS

The use of signal lamps for daytime signaling on electric railroads as well as for night signals, thus dispensing with semaphores and operating mechanisms, has been the subject of extensive experiments and study lately.

The recent introduction of hooded lamps and the development of the lenses and artificial backgrounds has gone a long way in placing this simple equipment far ahead of the old-style moving mechanisms and semaphore movements over the face of a stationary light.

The first signal system based on scientific principles, for both day and night service, was on the Brooklyn Bridge in 1907. The signals had 5-inch lenses, giving both red and green indications and were equipped with 10-inch hoods. These lights were not equipped with any artificial background. Behind the lenses were mounted 16 c.p. lamps. These proved only partly satisfactory and from then until 1911 there were but few attempts made to use lights for daytime signaling.

In 1912 the use of deeper hoods, artificial backgrounds and the strong white light of the tungsten lamps so improved the signal as to provide the first long range indications under the most severe daylight conditions.

The latest development of this phase of railroad signaling is the successful installation and operation of over 50 miles of these signals on the system of the Indiana Union Traction Company. These signals have 40-watt lamps and 8-inch hoods, and in daytime the signal indications can be read clearly at 3500 feet and at night over 2.5 miles.

One important feature in the use of the daylight lamps, that conclusively at-

tests their value, is the correct reading of the indication. Even the small 15-watt lamps with 8-inch lenses can be read at about 2000 feet under ordinary conditions of daylight.

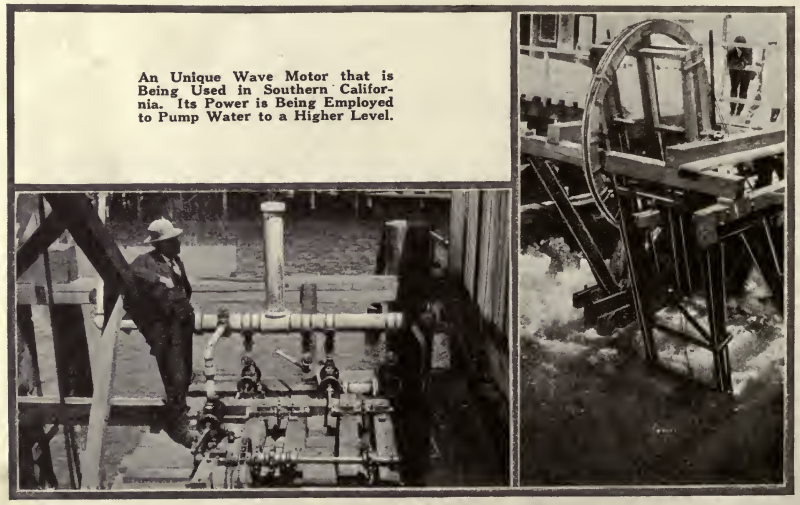
The difference in first cost of the installation and the less cost of operation recommend their use in all the modern equipments and they are being fast adopted to replace the older and more costly equipment on many of the large interurban electric lines throughout the country.

POWER PRODUCED BY THE FORCE OF THE WAVES

The great wasteful force of the waves as seen along the Pacific Ocean has set a large number of inventors to the task of claiming this great power and making it do their will. The result is that a dozen or more different types of wave motor are being tried out from time to time with more or less success. One of these inventions is installed at Venice, Cal., and with it the sea water is pumped to a height of forty feet.

A wooden wheel ten feet in diameter is suspended by a wooden framework built out over the water from the pier about twenty feet. From the wheel to about two feet below the surface of the water extend two heavy timbers which are connected with a wooden plane placed to receive the full force of the waves.

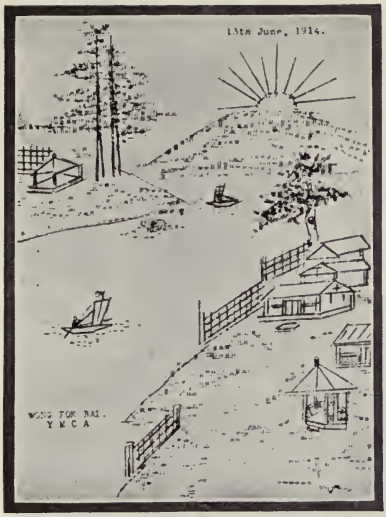
The plane is driven shoreward violently by the incoming breakers and just as forcibly driven back by the receding waves. This force revolves the large wheel and is transmitted to the four pumps by means of steel wire cables, and the water is carried upward forty feet through a three-inch pipe. To generate electricity they plan to pump this water into a storage tank, allowing it to run through a turbine.



An Unique Wave Motor that is Being Used in Southern California. Its Power is Being Employed to Pump Water to a Higher Level.

MAKING LANDSCAPES ON A TYPEWRITER.

Wong Fok Bai, a Chinese boy of Shanghai, won to American ways of living and thinking by the Y. M. C. A. of Shanghai, is an artist on the typewriter. He is not only a rapid and accurate typist, but he is also proficient in type-drawn landscapes. One of his type-drawings, "A Chinese River at Sunrise," was



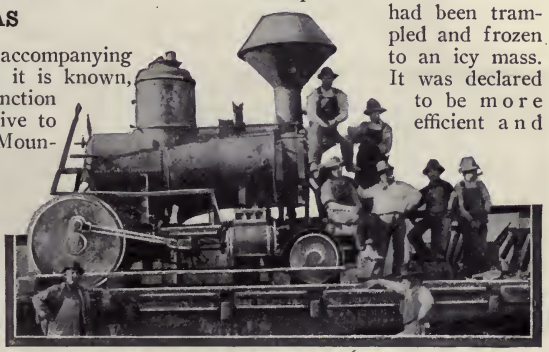
A Landscape Picture Made on the Typewriter by a Young Chinaman.

recently submitted to a leading typewriter manufacturing company in the United States and was pronounced the most excellent type-drawing ever submitted to the company.

Wong is nineteen years old and expects to come to the United States as a student in a year or so.

THE FIRST LOCOMOTIVE OVER THE SIERRAS

The engine shown in the accompanying illustration, Old No. 4 as it is known, built in 1865, has the distinction of being the first locomotive to cross the Sierra Nevada Mountains. For forty years an uninteresting junk heap, this engine has at last been rescued from a life of oblivion and restored to its original dress in order to be an interesting feature of the railroad exhibits at the Panama-Pacific Exposition. The old locomotive is of the wood-burning variety, with a diamond-shaped funnel, typical of the locomotives of that time.



An Old Time Engine that has the Distinction of Being the First Locomotive to Cross the Sierra Nevada Mountains.

REMOVING HEAVY SNOW DRIFTS WITH AUTOMOBILE PLOW

Still another use has been found for the automobile, this time as the power behind the snow plow. The cleaning of the city streets after a heavy snowfall has always been one of the biggest problems to confront the municipal officials, as the work must be done thoroughly and, before all, speedily. The use of large numbers of men with shovels is by no means an economical and reliable method, and yet heretofore it has been the only available means of the street department.

Now a plow has been devised which is fitted in front of a motor car or truck; the power required varying according to the heaviness of the snowfall and the amount of traffic which has beaten it solid. Both for city streets and country roads, the new invention has been tried out and proven a success. In New York county, drifts of 18 inches depth have been handled with ease by this plow on a standard automobile, and in one case the road had been practically impassable for three weeks, yet the hard-packed obstruction was cleared away in three hours.

In New York City the street commission gave the device a trial and it received the indorsement of officials, although it was severely tested on streets that were hard packed with old snow that had been trampled and frozen to an icy mass. It was declared to be more efficient and

Two Views of a Steel Snow Plow that May be Employed Either on a Pleasure Car or a Motor Truck, as Shown.

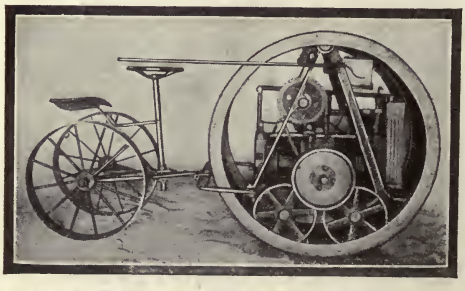
also speedier in operation than horse-drawn plows.

The steel plowshare of the auto snow plow resembles the prow of a battleship, although sometimes it is found more effective to use a blade that pushes the snow to only one side, instead of to right and left. Both types are shown in the accompanying illustrations; in one case a motor truck being used, while in the other a pleasure car supplies the motive power.

GASOLINE ENGINE OF NOVEL DESIGN FOR TRACTION PURPOSES

One of the most peculiar designs of farm tractors is that of a small gasoline engine which runs on the inside surface of a big wheel and thereby moves the tractor over the surface of the ground. Its operative principle may be compared to a squirrel in a revolving cage, climbing the sides to get exercise. The engine is cranked like most motors and possesses a good-sized balance wheel and other familiar automobile devices. From 12 to 15 horsepower is developed by the engine and it can be used with all forms of farming implements, such as a plow, harrow or cultivator. It can even be hitched between the shafts of a buggy and, when highly geared, will roll its owner about.

When the tractor is placed on the market the diameter of the cylinder will be about four feet. This will reduce the present weight of the experimental model, which is 1,600 pounds. The price of the machine when marketed will be about $300.00, or the price of a good team of farm horses.



A Gasoline Traction Engine in Which the Application of Power is Very Unusual.

It is said that Russia has a total of 137 electric central stations serving nearly 15,000,000 people.

Mechanical Man of the Merchant Marine

By Walter S. Hiatt

THE inauguration of an American Merchant Marine opens up a new and important field of endeavor for the trained electrical and mechanical men of this country. The average American is prone to regard the man who goes to sea as a sailor and it is probable that but few of us realize the opportunity presented by the modern steamship for trained mechanicians. In this timely article the author offers a suggestion worthy of note by the wide-awake mechanic and electrician.

CONSIDER 20,213 marine engineers! Put that number in your head and then read on. The placing of ships under the American flag has a big import to the man ashore with an engine room training and a technical education. These several hundred ships being registered for foreign trade mean not only that the merchants of the United States will get better freight and selling facilities, that the shipping industry will get the money that formerly went into foreign pockets. These ships mean that a good many thousand more jobs will be open to the American who wants to go to sea as an officer, oiler or electrician in the engine room. Formerly these jobs have been held by foreigners; now the best of them will have to be held by American citizens.

The engine room of a ship is an unknown quantity to the average American. He has been educated to believe that the only man who goes to sea is a sailor. In the modern steamship, the contrary is true. The majority of any ship's crew is below decks. The fate of the able seaman is indelibly attached to the ship of sail, and the fate of the ship of sail is told in these figures: During the past year, the shipyards of the United States turned out but 73 sail vessels, as against 1,003 of steam; while in the year 1910, 127 sail vessels were built as against 936 steamers. The records of every nation of the world duplicate this decrease in sailing ships.

In other words, while there will always be room for the seaman, his rôle is no longer the paramount one aboard ship, from the point of view of numbers. In the early 'forties, when Dana voyaged in the little freight brig *Pilgrim* and later wrote his "Two Years Before the Mast," the crew of fourteen, save two, were actively engaged in working the ship.

Now consider a steam freighter of today. Take the *Panama,* of the American-Hawaiian line. Her crew consists of 39 men—rather lower than the average because she burns oil instead of coal. The largest number of men, namely, 17,

The Engineer Works on the Level—Sea Level—Below Decks, Out of Sight of the Passengers.

in any one department, are found with the engineer—one chief engineer, three assistant engineers, one deck engineer, three oilers, three water tenders, three firemen and three wipers.

When it comes to passenger vessels, the number of men in the engineer's department is simply enormous. On a 12,000-ton vessel like the *St. Paul*, of the American Line, there is a crew of 400. Other than the two wireless men, there are 167 in the engineer's department of which number 22 are officers, cadets and electricians.

But what about that number —20,213? This is the number of engineers employed in the water transportation of the United States, in lake, river and coast-wise vessels only. Are these jobs held right now by Americans? Hardly. Of natives there are 10,526, and the rest are largely foreigners who have come over here to get a good job. So far has the average American stayed from the water that he doesn't know about the good jobs already found for him right at home.

What will be the chance for the American engineer with hundreds of ships operating under the American flag? Already some 200 ships have been newly draped with the red-white-and-blue banner, and others will follow. These ships must carry, by law, after two years, American officers on the bridge and in the engine room. Watch officers, they are called. In addition, they must carry cadets; that is, young fellows who want to learn the business of going to sea.

The wages paid engineers and assistants make such jobs attractive. A chief engineer under the American scale of wages on a good ship averages one hundred and fifty dollars. The sum may rise above or fall below that, according to the ship.

What makes this business of going to sea attractive, in particular for the engineer, is that if he decides after all he would rather stay ashore his original training makes him able to hold down the shore job, and his rough-and-ready work at sea has made him all the more valuable ashore. I recall the case of an engineer of the *Ulstermore*, a Johnston line ship that ran from Baltimore to

A Passenger Ship at Sea. How Quickly She Does Her Work!

Liverpool. The engineer of that ship was a tall, brawny Scot, and he knew his job from stem to stern. The ship met a January hurricane while in mid-Atlantic, and the plunging of the ship, throwing the propeller out of water every two minutes, wound up by jerking one of the blades loose. Of course, that blade dropped off and there was the ship stopped in a bad storm with the waves rolling over her and dashing into the funnels. Well, that engineer decided he would keep that ship going. He manination which will entitle him to a marine license. In every big customs port of the United States—New Orleans, Chicago, San Francisco, New York—an examination for a license may be taken for the asking. The United States Department of Commerce issues a pamphlet giving the qualifications required to be shown in the examination. To get the marine license, the applicant must have had three years' experience on a steamer, or else he must offer evidence of training with stationary engines, graduation

A Marine Engineer with a Shore Job at Panama. Here is Seen One of the Electric Towing Locomotives that Haul the Steamers Through the Locks of the Canal.

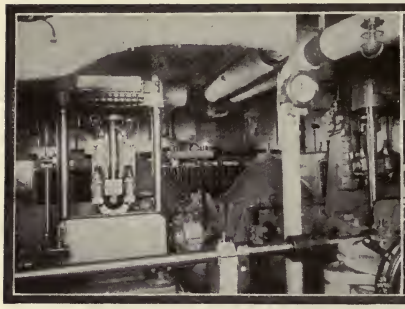
aged to turn the engine over so slowly while the propeller was out of the water that the remaining blades did their work without being jerked off in their turn. He stayed at the job three days and three nights, until the sea quieted down.

When that ship got into Liverpool, that engineer was taken off the ship by the owners and given a crack job as marine superintendent.

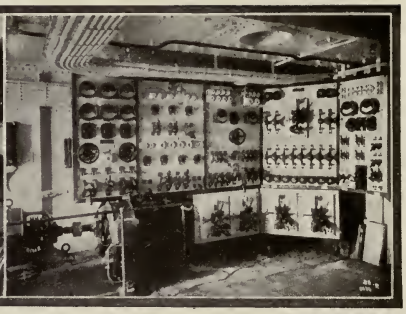
So it's a rule that works both ways. The man who has already learned his trade ashore can easily pass the examfrom a mechanical engineering school or training in marine construction works.

Taken all in all, this business of going to sea is healthy; it rounds a man out, gives him the horizon that comes with a little travel, let's him see how other fellows work in other places, and the pay is worth while, considering that food and lodging always go with the humblest of sea jobs.

The inauguration of the American Merchant Marine at this time is most opportune. The European war and



Rudder Machinery of a Liner. It is Part of an Engineer's Work to Attend to this Equipment.



The Dynamo Room of a Large Passenger Steamer. Here the Electrician is Much in Demand.

other factors have caused serious business depression in most industries, with the result that there is considerable unemployment. Until general business conditions improve—and the prospects are said to be uncertain and not overencouraging—it is very probable that unemployment will continue to confront many in the mechanical trades. But the possibilities of work on board the steamers of the American Merchant Marine just now offer an opportunity for employment to the more ambitious men.

CITY STREET MAY SLIDE INTO RIVER

Occupants of the office buildings on the main street of Edmonton, Canada, are facing a strange calamity, for the street, which is built along the steep bank of the Saskatchewan, threatens to slide into the river.

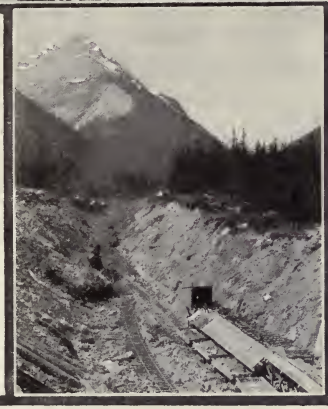
Larger and more substantial buildings have been put up in recent years to meet the increasing demand of the western Canadian wheat industry, with the result that the countless tons of stone and brick used in their construction are putting an enormous pressure on the insecure earth foundation.

Landslides have Carried Away Most of the Main Street of Edmonton, Canada, and are Now Threatening Buildings.

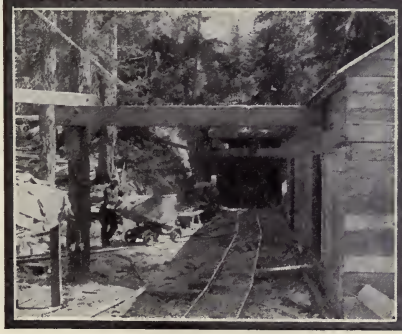
Some time ago the earth showed a tendency to sink toward the river, and, in fact, a noticeable movement was observed at several points. Notwithstanding the war burden which Canada is forced to carry, an appropriation of $5,000 has already been made for the purpose of stopping the slide.

At least 25 per cent. of the larch timber over large areas in eastern Oregon has been killed or weakened by mistletoe, and the forest service is taking steps to combat this troublesome pest.

AMERICA'S LONGEST TUNNEL



Away off in the snow-clad Selkirks of British Columbia modern science is pitting its wits against the forces of nature; there the men of the steam shovel and drill are wending their toilsome way through Mount Macdonald to form a tunnel five miles in length—the largest bore of its kind in America, for the Canadian-Pacific Railroad.

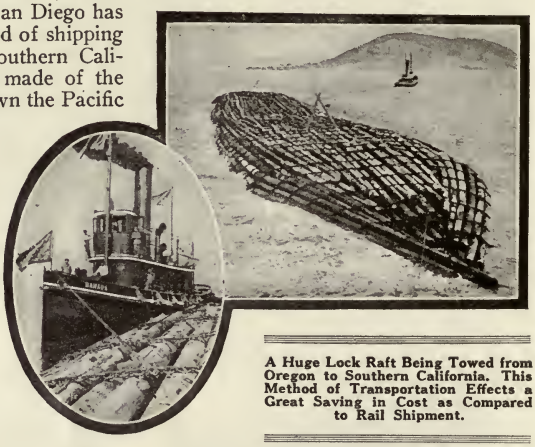


OCEAN-GOING LOG RAFTS

To compete successfully with the high-priced timber of the Southwest, a resourceful log importer of San Diego has adopted an ingenious method of shipping lumber from Oregon to Southern California. Gigantic rafts are made of the logs, and they are towed down the Pacific Coast behind small steamers.

The rafts are cigar-shaped and average 700 feet in length, 30 feet in depth and 70 feet across. Two-thirds of the raft is under water. The chains on a single raft weigh 115 tons and cost $10,000.

The first sea-going log boom made its thousand-mile trip eight years ago, and since then twenty-nine of the huge rafts have followed that course. An average of five rafts a year are now towed to San Diego. This year, one raft was compelled to turn back on account of the bad weather.

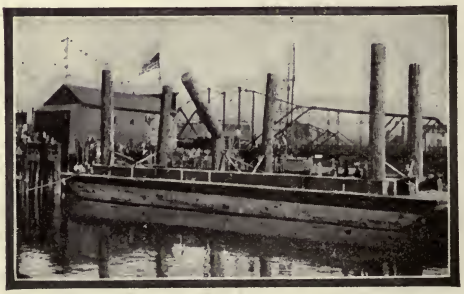


A Huge Lock Raft Being Towed from Oregon to Southern California. This Method of Transportation Effects a Great Saving in Cost as Compared to Rail Shipment.

TREE FELLING CONTESTS

Contests in tree-felling, as they are generally called in the northwest, have many elements of the picturesque, with the lithe figures of the saw-men swinging in perfect rhythm on the seemingly precarious footing of their spring-boards; the stately trunks bending, swaying ever so lightly, and suddenly toppling to a fall in their absolutely predestined position. The skill, the swiftness, the sureness of the attack appeal.

The trunks illustrated were forty-four inches in diameter, and the records of the prize-winning teams were seven minutes, fifty-six seconds, and eight minutes, respectively.



Tree-Felling Contests are Intensely Interesting and Contain in No Little Measure the Element of Excitement.

SOCIETY ELECTRIFIED

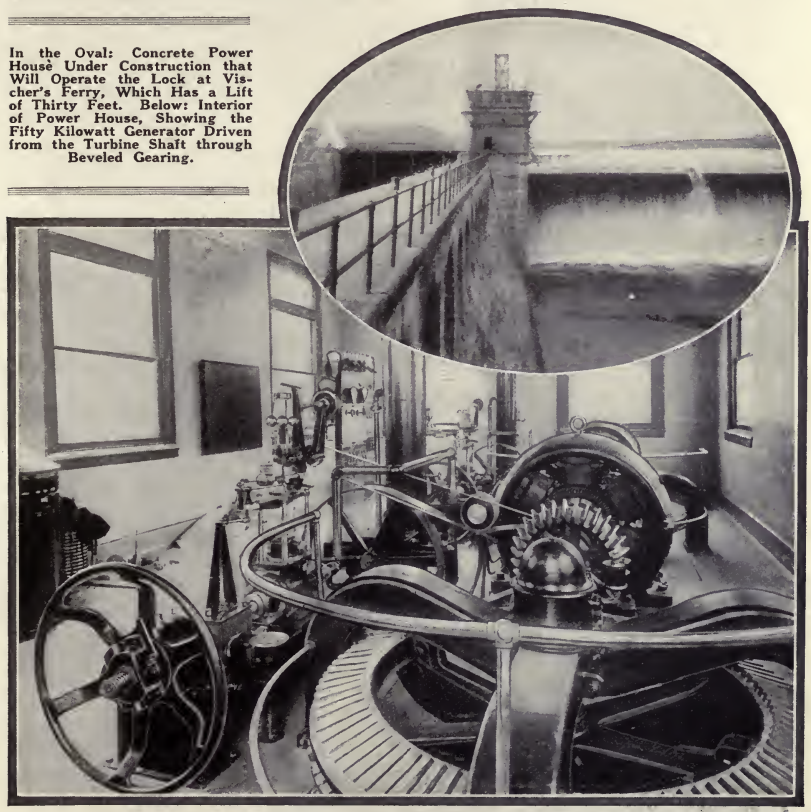
A new and popular social event is the Electric Wedding, held on the first anniversary of the marriage, after which the old order is carried out in its usual sequence, or the first is omitted and the others celebrated in the accustomed order. Such things as lamps, clocks, cigar-lighters and electroliers for the living-room, the library and the bedroom, and percolators, chafing dishes, toasters, stoves, irons, etc., for the kitchen and dining room, cause the bride to rejoice at this innovation. The various finishes obtainable for these conveniences, nickel, brass, bronze or some glazed composition, make it possible to have the gifts in harmony with the other furnishings of the home.

ELECTRIC LOCKS OF THE NEW YORK BARGE CANAL

The entire fifty-seven locks of New York's great barge canal system, now nearing completion, will be operated by electric power. For this purpose the state is building thirty-three hydro-electric power stations, ten gasoline-electric plants and three sub-stations. From the big power plant at Crescent Dam, current will be supplied for operating five nearby locks which have an aggregate lift of 169 feet. In most other cases each lock will have its own individual power plant, the energy being obtained from the fall of water in the canal at that point.

The power houses are uniform in size and architecture. They are about 20 by 30 feet in plan and 20 feet high. The walls and floors are of reinforced concrete and the roofs are of tile. Each power house is equipped with a three-ton electric crane. Four 100-watt tungsten lamps are provided for illumination at night.

The hydro-electric stations are equipped with two units, each consisting of a 50-kilowatt generator driven by a 100 horsepower water turbine. Direct current is furnished at 250 volts. The gasoline plants are driven by two engines designed to operate at a speed of 650 revolutions per minute.



In the Oval: Concrete Power House Under Construction that Will Operate the Lock at Vischer's Ferry, Which Has a Lift of Thirty Feet. Below: Interior of Power House, Showing the Fifty Kilowatt Generator Driven from the Turbine Shaft through Beveled Gearing.

The locks are 45 feet wide, with 12 feet of water on the sills. They have a usable length of 311 feet and will accommodate two barges of 1500 tons capacity. They are of massive concrete construction. The gates are of the mitering type, constructed of steel plates and beams. The locks and approaches will be lighted at night by a dozen or more magnetite arc lamps.

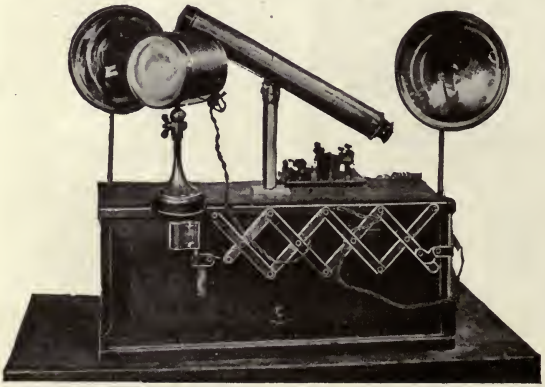
Each lock gate will be opened and closed by a steel spar actuated by a seven horsepower motor set in a recess in the lock wall. The valves which control the culverts for filling and emptying the lock chamber will be raised and lowered by motors of three horsepower. The machinery is all controlled by master switches located on operating stands at each end of the lock. Automatic signals and limit switches serve to prevent confusion or accidents. All the motors are designed to be fireproof and waterproof.

An electric capstan is placed at each end of the lock to assist boats in entering and leaving the chamber. The capstan has a 20 horsepower motor designed to exert a pull of 8000 pounds at a speed of 60 feet per minute. A telephone system will connect the several locks. The entire equipment has been designed especially for the barge canal, and it is expected to prove highly efficient in actual service.

NEW SIGNALING SYSTEM COMBINES WIRELESS AND HELIOGRAPH

A wireless equipment and heliograph signaling apparatus are combined in a new signaling system devised by a New Yorker.

A portable apparatus of this type makes it possible to signal between rapidly traveling railroad trains, trains and signal towers, and between ships at sea. It includes the usual wireless apparatus, with the ordinary antenna erected on the engine cab, ship or tower, as the case may be, for the transmission of signals. Signals by means of light waves are transmitted through the agency of a reflector of concave form, fitted with an electric bulb at its center. The lamp within the focus of the reflector gives a beam of light that can be intermittently flashed for giving a passing station a private message, under the control of a switch. Either one of the antennæ of the apparatus may be rendered operative at will for either wireless or flashlight signaling.



Portable Apparatus that Permits of Signaling by Wireless and Heliograph Between Moving Railroad Trains and Signal Towers.

American manufacturers of electrical devices would do well to consider carefully Siberia as a possible field for their wares. In that country the development of electricity is now taking place, and there is an increasing field for electrical devices.

A FACTORY THAT GOES TO MARKET

by Frank Hepburn Crawford

IN eliminating transportation expenses and loss of time, a firm manufacturing pavement blocks recently conceived and put into commission a plant mounted on railroad cars, enabling the machinery to turn out the product at the spot where it is to be used. The idea is quite unusual—and it might be adopted by other manufacturers.

AN asphalt block manufacturing plant equipped to go after business in the most literal sense of the word is one recently designed by a pavement company and first put into practical operation at New Castle, Pennsylvania, during the present year. Every unit of this plant—from the steam power outfit to the 96,000-pound hydraulic press—is built on freight cars.

The plant as at present operated is mounted on eleven cars, two of them being specially constructed steel flat cars of 150,000 pounds capacity each, with only 3 feet 2 inches from rail to floor, in order to provide proper clearance for their unique load when the factory is in transit.

The power unit consists of five marine type Seabury safety boilers and a 250 h.p. three-cylinder compound marine type engine. To those familiar with New York harbor craft it will be of interest to know that one of these boilers was formerly in the private yacht *Vamoose,* which a few years ago was the speediest craft in American waters.

The plant's stone crushing unit requires one of the specially built 150,000 pounds capacity cars. In addition to the elevating and carrying equipment, it consists of two sets of 36 by 16 inch crushing rolls weighing fourteen tons each, and two 12-foot cylindrical screens weighing six tons each, screening to a 3/16-inch diameter. The crushed stone is automatically carried from the screens to a specially built vertical type stone heater where it is raised to a temperature of about 330° Fahrenheit. It is then conveyed automatically to a double shaft pug mill of 31 cubic feet capacity into which are also fed the filler and cementing materials.

These ingredients when thoroughly mixed at the proper temperatures are elevated by a skip car to the press, which is operated on a hydraulic principle and consists of a multiple mould turret, weighing five and one-half tons, where

The Asphalt Cement Manufacturing Unit of the Plant Alone Requires Four Cars for its Transportation.

cement manufacturing unit requires four cars, and includes two boilers, two compressors and four tanks, the largest of which is 25′ long, 13′ high and 9′ wide. The asphalt steam refining tank contains about 7,000 feet—considerably more than a mile—of 1¼-inch extra heavy electrically-welded pipe. The finished cement is drawn off by gravity from one of these tanks into a small blow tank and is then forced by compressed air about sixty feet through a 6-inch line into another receptacle from which it is drawn for the purpose of making blocks.

A thirty-six-foot box car is utilized for the machine shop. In this car are lathes, shaper, grinder, drill presses, an oxy-acetylene welding outfit—in fact, all the machine tools required for ordinary construction and repair work. With its dozens of countershafts and pulleys and belts and cones and the surprising diversity of its equipment, it is a marvel of compactness and not the least interest-

the process of filling, pressing and ejecting are carried on simultaneously. This press unit requires the second 150,000 pounds capacity car. Each block is here given three degrees of compression, the possible ultimate compression being three hundred tons to a 60-inch surface, or 10,000 pounds to the square inch. The blocks are then automatically transferred into conveyor belts which carry them through one hundred and fifty feet of cold water, and from the end of the belts they are loaded direct on cars for shipment, an average day and night run being 25,000 finished blocks 5 by 12 inches by 2 to 3 inches thick, depending upon the traffic to which they are to be subjected, and weighing from 11 to 16 pounds each, depending upon the thickness.

The factory on wheels manufactures its own asphaltic cement from imported natural Trinidad asphalt, and its own petroleum product fluxing material. The asphaltic

By means of Conveyor Belts on this Long Car, the Finished Blocks are Carried Through 150 Feet of Cold Water.

ing feature of this unusual manufacturing establishment.

Another thirty-six-foot box car serves as a store room for the thousands of pipe fittings, bolts, nuts, screws, taps, drills, wrenches and general supplies which are kept in perfect order and as readily accessible as on the shelves and racks of a hardware store.

The device for testing the blocks made at this plant is noteworthy. It consists of a specially constructed rattler, or rotatable drum, mounted on a shaft, the inner periphery of which is paved with one square yard of blocks to be tested. The entire apparatus is enclosed in an insulated box, in the interior of which are separate coils of pipes for reducing or raising the temperature of the box. By means of an ice machine the temperature is first reduced to 8° below freezing, at which point it is kept for one hour. There are then introduced one dozen cast iron cubes aggregating 50 pounds in weight and the drum is next revolved 10,000 revolutions at 37 r.p.m. Before the blocks are set in the drum they are weighed and after the 10,000 revolutions they are taken out and weighed again. The difference in the two weights represents the loss in pounds per square yard by the pounding and abrasive action of the sharp-cornered iron cubes.

A Section of the Portable Manufacturing Plant that is Now Mounted on Eleven Cars.

Limestone Crusher on its Specially Built 150,000 Pound Capacity Steel Car.

Exactly the same process is next carried out with a fresh set of blocks; only in this instance, by means of steam, the temperature of the interior of the box is raised to 90° Fahrenheit. This test represents what experience shows to be the equivalent of ten years of traffic wear on a busy street and determines whether the blocks are up to the standard specifi-

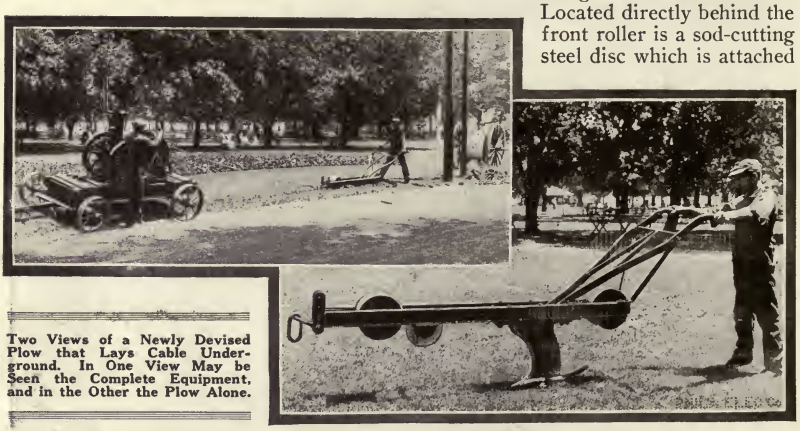
cation which this factory sets for its product.

With a complete plant built on freight cars and capable of being moved from city to city, and a skilled corps of workmen to operate it, the production of paving blocks can readily be accomplished at any point where street improvements are contemplated on a scale sufficiently large to warrant the expense of moving and the subsequent reassembling of the plant.

It is believed that this mobile factory is unique in its conception, and it is of more than ordinary interest in view of the unusual engineering skill required to accommodate the mechanical necessities of a potentially profitable plant to the limitations of freight car dimensions and railroad traffic regulations.

PLOW LAYS CABLE UNDERGROUND

In a great many cities it is necessary to lay electric light and telephone cables underground. To do this by manual labor or by placing the cables in conduits is a very expensive undertaking and constitutes one of the biggest items of cost in the maintenance and construction departments of public service companies.



Two Views of a Newly Devised Plow that Lays Cable Underground. In One View May be Seen the Complete Equipment, and in the Other the Plow Alone.

To overcome a portion of this expense a public service company in Philadelphia has developed within its own shops a special plow that cuts a deep groove in the ground and lays the cable at the same time. The machine does not throw out any earth, and after the cable is under the ground all that is necessary to complete the work is tamping.

The plow is drawn by a cable attached to a drum that is driven by a gasoline engine mounted on a small truck; the cable being supported by the usual large reel. Two wide rollers are mounted between two channel frames, and these rollers support the plow as it travels along the earth's surface. Located directly behind the front roller is a sod-cutting steel disc which is attached to the underside of the channel bars. The cable itself is securely fastened to the point of the plow and as it digs down into the earth it buries the cable with it. As a time and labor saver it is one of the best of recent inventions in the field of telephone and electric cable work.

The International Electrical Congress will be held at the Panama-Pacific International Exposition from September 20 to 25, 1915.

DEFEATING THE SUBMARINE BLOCKADE

How the Much-Discussed English Channel Tunnel Would be of Great Value at Present for Military and Peaceful Purposes

By Ernest Busenbark

"I THINK that the existence of a tunnel (under the English Channel) would be a great inducement to France to invade England." Thus spoke Lord Wolseley before the House of Parliament in 1881.

The thirty-four years intervening between that time and the present have witnessed a rapprochement between England and France which reached its climax when these two countries became allies in the combat with Germany. The unfavorable attitude of the British towards an under-channel tunnel has become less obdurate, if not entirely favorable. The German submarine blockade has emphasized the need for such a tunnel, since military supplies, food, merchandise, and even soldiers could then be transported between France and England without danger or possibility of interference. Furthermore, it would permit of greater mobility to the Allied army. For instance, practically all the men of the British army could be concentrated in France, yet at a moment's notice they could be brought back to England and sent to any point of the island in case of threatened invasion by the Teutons. Under the present conditions England is obliged to keep an army at home as a precaution against eventualities.

Let us consider the question from another point of view—from a peaceful standpoint, since the war is only a temporary condition. It is well known by travelers that the English Channel is one of the roughest stretches of water to travel across in a steamer. Were it not for the thirty odd miles separating England and France, it would be possible to travel between Paris and London in a shorter time and the trip would be a more pleasant one. It would bring England and France into still closer relationship, since such a tunnel, offering through train service between the two countries, would encourage natives of one country to visit the other. In brief, it would make England part of the mainland yet would not jeopardize her military advantage of being surrounded by water.

The English Channel project is not a new one. It dates back more than one hundred years. In almost every decade since 1802, at the time when engineer Mathieu laid before Napoleon a project for a tunnel under the channel, the plan has been resuscitated, revived temporarily then hastily shelved because of the strenuous objections raised.

In 1872 a company capitalized at $400,000 was formed under the direction of economist Chevalier to make necessary researches and plans for the tunnel. One-quarter of the shares were taken over by the Rothschild brothers and one-half by the North Railroad Company. The tunnel company asked no subsidy from the French government, but pledged itself to carry out the preparatory work—at least to the extent of its capital. Negotiations with the authorities opened at once and in 1875 the necessary charter was granted; the tunnel being bored from the French side was to meet another section starting from the English coast.

The preparatory work was carried out and the general observations made were deemed very encouraging. Under M. Ludovic Breton, shafts and galleries were sunk near Calais at Sangatte to 55.20 meters below sea level. In 1883 this gallery was 1839.63 meters in length, about 156 meters of it having been dug by hand. The conclusion from the initial survey was that the tunnel project could easily be carried out, since it would go through what is known as "Rouen Chalk," which is quite soft, yet impervious to water. The chalk forms the bed of the channel down for a good distance.

It was planned to construct two cylin-

drical tunnels of 5.50 meters in diameter each, spaced 15 meters apart; the sections to be connected by cross galleries at convenient intervals. The total mileage of the railroad track—figuring on the basis of one track in each tube—was estimated at from 50 to 60 kilometers. The total cost was placed at approximately $50,000,000.

Sir John Hawkshaw and Engineer Brunlees first brought up the proposition in England in 1869 and it received favorable attention, but the Franco-Prussian war broke out shortly afterwards and the discussion stopped.

The tunnel project again came up in 1872 and a company was formed which succeeded in securing from Parliament about the same privileges as had been granted to the French company. However, their concession was allowed to expire without anything having been accomplished.

The South Eastern Railway then took up the subject in conjunction with the French Company. Work was begun near Dover at Shakespeare's Cliff and was well under way when a distrust for the plan took root and it became the subject of lively discussions in Parliament. The more conservative element feared that it could not be successfully defended against invasion in time of war; that it would result in a large loss of trade to London shopkeepers, and the increased travel between England and France would tend to a greater assimilation of continental characteristics, to the detriment of English individuality. Discussions pro and con became so spirited that Parliament finally appointed a committee to investigate and report upon the plan. The opinions of the Committee were evenly divided: Some of the members were in favor of it and submitted ideas for protecting the tunnel against invasion by means of mines, by flooding, and by the construction of a fortress which would overlook the tunnel entrance. But in the debates that followed it was practically overthrown single handed by the speech of Lord Wolseley, an excerpt of which follows:

"Surely John Bull will not endanger his birth-right, his liberty, his property, in fact all that man can hold most dear, whether he be a patriot or merely a selfish cosmopolitan, whether this subject be regarded from a sentimental or from a material point of view, simply in order that men and women may cross to and fro between England and France without running the risk of sea sickness. Even now, when protected by our 'silver streak' we suffer from periodical panics which are as injurious to trade as they are undignified; this tunnel would render their recurrence much more frequent, thereby increasing the loss they occasion. The night does not follow the day more surely than will a vastly increased annual military expenditure follow upon the construction of a tunnel. Are we to be taxed additionally for these new military assessments in order to save a certain number of travelers and tourists of all nations from sea sickness?"

Work was stopped at once, but there was so much fear that it would still be carried on secretly that a guard, with surveyor's chain, was appointed to see that it did not continue.

In France hope was not given up and plans were made that would allay the fears of the most timid. Starting from either end a 5-span bridge would run into the sea for about one mile, connecting with the tunnel. At this point huge elevators would take the trains down 62.5 meters, to the rail level. At the first alarm, the bridge approach and connecting entrance to the tunnel could be destroyed with a few shots, so that invasion from that source would be impossible. A variation of this plan was to construct a viaduct, circling the cliff of Cape Blanc Nez in France and Shakespeare's Cliff in England, which trains would have to pass in descending the slope to the tunnel. Shore batteries guarding the viaducts at either end would absolutely remove the possibility of its use in time of war.

Since 1880 the tunnel proposition has been brought up several times; once in 1906 and again in April of last year, but the British War Office and Admiralty have succeeded each time in putting a damper on it.

Today France and England stand united more firmly than ever before. No longer does England fear a French invasion. Fear has given away to firm friendship, and the result of this war has already been to unite the two countries, making their interests and sentiments common.

WHAT A KILOWATT HOUR WILL DO

MANY who use electricity for power or illumination puzzle over bills for current consumed, and, not being familiar with the meaning of technical terms, they give it up in despair and pay without protest, although secretly nursing a feeling that they are perhaps being cheated through their ignorance of such terms as watts, kilowatts, amperes and volts.

What is a kilowatt hour of electricity and what will it do? Kilo comes from a Greek word which means one thousand, and kilowatt is one thousand watts of electricity. But what is a watt? The word watt comes from James Watt, the Scotch inventor, and it means the practical working unit of electromotive force of one volt when the flow of the current is one ampere. Expressed in figures it equals 0.00134 horsepower or 0.737 foot-pounds per second. A kilowatt thus represents just one thousand times this power.

A kilowatt hour means the continuance of this force for one hour. A kilowatt hour of electricity will perform many wonders that few realize, while its expression in ordinary terms may help to illustrate it better to the lay mind than technical words.

For instance, a kilowatt hour of electricity will carry you three miles in an electric automobile, or it will carry you up thirty times from the bottom of a shaft 80 feet deep.

It will keep your coffee warm at the breakfast table every day for a week, or run your sewing machine for 21 hours.

It will keep your breakfast warm for five hours or run a small ventilating fan for 21 hours, or a large one for six hours.

It will cook 15 chops in 15 minutes, or boil nine kettles of water, each holding two pints of water.

It will warm all the beds in your house by means of a warming pad for two weeks, or give you heat in your bedroom for an hour while you are dressing or undressing in very cold weather.

It will keep four ordinary irons hot while in use for an hour, or keep you warm in bed for an hour.

It will give you three Turkish bath lights, or run an electric piano for ten hours.

It will lift three and a half tons 75 feet in four minutes or pump 100 gallons of water to a height of 25 feet.

It will run a plate polishing machine for 21 hours or fill and cork 250 dozen pint bottles.

It will supply all the air required by an ordinary church organ for one average service, or run an electric clock for ten years.

It will light 3,000 cigars or iron 30 silk hats.

It will knead eight sacks of flour into dough or run a mechanical sieve for two hours.

It will warm your shaving water every morning for a month or warm curling tongs every day in the year for three minutes and twice on Sunday.

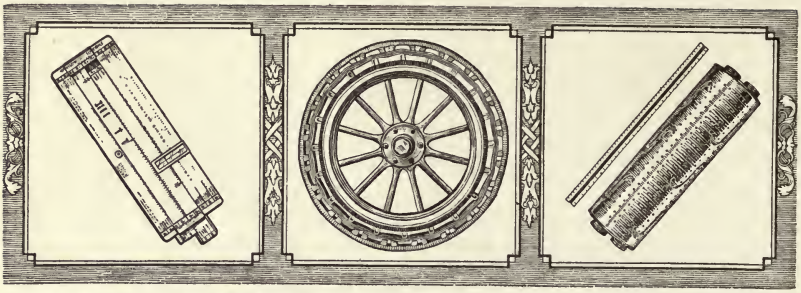
It will operate a machine long enough to clip five horses or another to clean 75 pairs of shoes by machinery.

It will drive machinery long enough to clean 5,000 knives or saw 300 feet of deal timber.

It will keep your feet warm for five hours in ordinary cold winter weather.

After one has read this list of things that can be accomplished with one kilowatt hour of electricity it is his own fault if he does not have a pretty practical idea of what the term means when translated into common language. Figuring at the usual rate of 10 cents per kilowatt hour, it is not a difficult matter to estimate approximately the cost of various tasks.

If you enjoy this magazine, tell your friends; if not, tell us. Why not hand this copy to someone else when you have read it through?



Slide Rule Computes Concrete. Flexible Tire. A Heater for Muffs.

RECENT AND IMPROVED DEVICES

Slide-Rule Computes Concrete

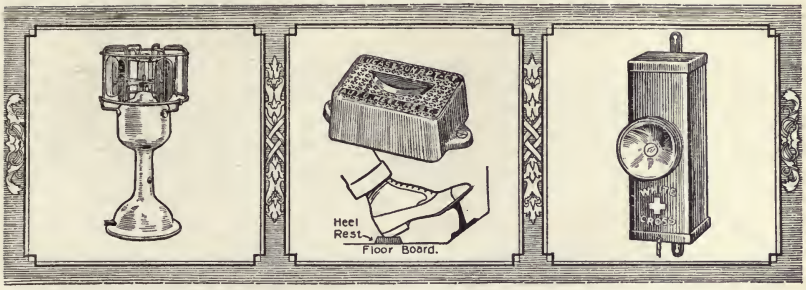
A slide-rule for quickly calculating reinforced concrete beams, girders and slabs has been devised. Its range is very wide, as it will calculate instantly any span from six inches to seventy feet, any load from ten pounds to fifty tons, any shape or size of rod, round or square, as well as any "mix" of concrete or any stress in the steel. Months of labor involving thousands of calculations were necessary in designing this rule, principally on account of the fact that seven to nine factors are involved. It is very compact, weighing about four ounces. The material used is hard fibre; the dimensions are 4 by 10 by 3/16 inches.

Flexible Tire

Since the rapid advance of the price of rubber automobile tires within the last few years, countless inventors have been working on the idea of perfecting some sort of tire which would not involve inflated rubber, or the pneumatic type, and the incurred shortness of life and the unpleasantness of punctures. One of the most ingenious examples of the new "mechanical tires" and one said to possess high resiliency and a surprisingly long life, embodies several pliable non-elastic bands under tension, separated by aluminum blocks. It will be readily seen that resiliency does not result from a pneumatic principle or from rubber compounds, as is usually the case. On account of the square edge, anti-skid properties are secured without the use of chains. By means of an adjusting arrangement the tire can be made harder or softer, to suit individual comfort. The new tire has been approved by the Royal Automobile Club of Great Britain, and it has passed the anti-skid test of Scotland Yard.

A Heater for Muffs

Whether or not the new fad of small muffs with their consequent decrease in warmth has stimulated the demand for muff warmers, the fact remains that a manufacturer has brought out a very small but decidedly efficient heater which, among other uses, is intended to be carried in the muff or pocket for warming the hands in extreme cold weather. It consists of a tinned iron case 4½ in. long partly covered with velvet. A paper covered cartridge is ignited and inserted, and it smoulders slowly for several hours, maintaining a constant temperature. No smoke or smell is produced owing to the peculiar composition of the fuel used. Moreover, the smouldering spark is not extinguished even when it is tightly screwed down in the case. Naturally, this heat giver may be used without risk of fire.



Horizontal Table Fan. Heel Rest for Pedals. Battery Porch Lamp.

The heater is made in various sizes, ranging from a tiny pocket case to an automobile foot warmer, which gives as much heat as a small stove.

Horizontal Table Fan

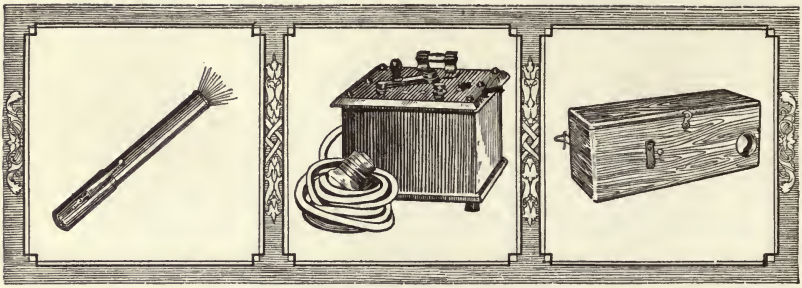
A somewhat radical departure in table fans is one in which the motor is upright and the fan wheel is arranged like the paddle wheel of a steamboat. A much greater artistic effect is secured in this design than in the ordinary propeller-like fan. The wheel is enclosed for protection in a small cage. The horizontal table fan is finished in white enamel and nickel plate to harmonize with the table linen, silver, china and cut glass. It is ornamental enough to be used for a center piece in warm weather. The air is distributed evenly around the table and at a sufficiently high elevation to prevent chilling of warm foods.

Heel Rest for Pedals

All sorts of provisions for the absolute comfort of the motorist seem to be the prevailing order nowadays. One of the latest creations is a small aluminum block to be placed under the heel to prevent its slipping and the foot becoming tired when a clutch or accelerator pedal is used. The heel of the shoe fits into an appropriate hollow in the face of the rest. The auto heel rests, as they are called, are made in various heights for adaption to all sorts of pedals. Small flanges project out from the bottom with screw holes, so that the rest can be fastened easily to the floor of the car. An added feature of the auto heel rest is that the life of the rubber car flooring is considerably lengthened, as sharp heels pressed against the floor by the weight of the pedal will wear holes quicker than anything else.

Battery Porch Lamp

The recent increased efficiency of the miniature tungsten lamp has resulted in the opening of a new field of activity for the prosaic dry battery. One of the most useful combinations of the battery and the new lamp is found in a recently introduced ceiling and porch light. The battery is contained in a weather and fireproof case, on the front of which is a reflector and the lamp. A cord hangs from a hole in the bottom and is connected to a switch on the inside, so that it operates on the same principle practically as the chain socket. Metal strips are soldered to the back and provided with screw holes for hanging the lamp. With a fresh battery the lamp will burn continuously for about forty hours, or if used intermittently, from six to twelve months. Although the lamp is designed for use on porches principally, it may also prove handy in dark corners and closets.



A Fountain Pen Flashlight. Safety Fuse on Toy Transformer. Electric Rain Alarm.

A Fountain Pen Flashlight.

The limits of compactness and ingenuity of design in pocket flashlights have been attained in a flashlight which looks exactly like a large-sized fountain pen. By pressing the clip by means of which the "fountain pen light" is held in the pocket, the light can be flashed. The light can be flashed or burned continuously as desired, and laid down while burning, so that the hands are free to work. A tungsten battery supplies the necessary current. The weight of the fountain pen light is 1½ oz. It is 5¾ in. long and ¾ in. in diameter.

Safety Fuse on Toy Transformers

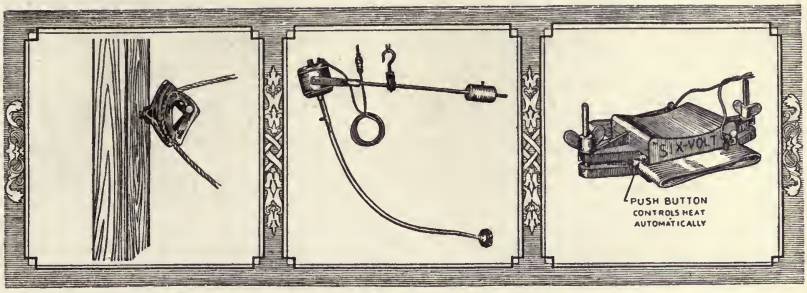
If a miniature train, operated by a toy transformer, should jump the track, a short circuit is usually caused, and if the circuit is not immediately opened, the transformer coils or the house fuses may be blown out. A new feature embodied in toy transformers has been introduced by a Detroit manufacturer. His transformers, which are of the lever-control design, are equipped with a small, low voltage fuse in the secondary or low voltage windings. In case of a short circuit, this fuse will be blown, thus protecting both the transformer coils and the house fuses. Inasmuch as the fuse is of the standard six-volt auto type, it can be readily replaced when burned out.

Electric Rain Alarm

Falling rain is likely at any time to drive into a room and damage the floor, wallpaper and furnishings. A Chicago manufacturer has devised an electric rain alarm which will give warning as soon as rain in any quantity falls into the room. The device consists of a box containing a battery, a buzzer, a small electric light, and a switching arrangement that holds what the makers call a "Raino-disc." The box is put on the window sill at night when the window is left open for ventilating purposes. The falling rain drops on the disc, switches on the current, and throws both light and buzzer into circuit. The buzzer awakens the sleeper, and the light shows which window needs attention. The latest form of this device has the raino-disc on top of the box instead of at the back. This new arrangement arouses the sleeper only when the rain is actually driving into the room thus avoiding false alarms.

Ingenious Clothes Line Clamp

A clothes line clamp which will hold the line securely claims superiority over most existing types, because it is constructed strongly enough to withstand the most severe strains which the clothes line itself is subjected to. The rope runs in a groove between a stationary fixture, which is attached by means of a long screw to the post, and a self-adjusting clamping device. When the rope is



Ingenious Clothesline Clamp. Electric Buffer Has Flexible Adjustment. Vulcanizer for Tires.

pulled tight the clamp presses tightly against it, thereby preventing slipping. Provision is made in the construction for the use of ropes of various sizes. Several coats of enamel make the clamp practically waterproof, so that it will withstand severe weathering.

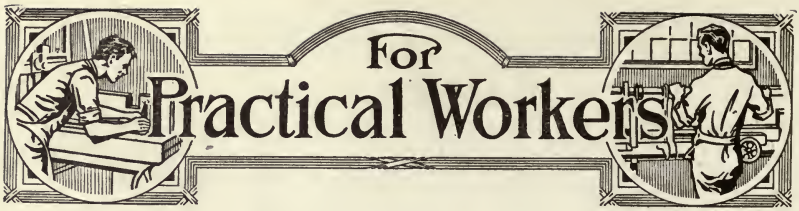
Electric Buffer Has Flexible Adjustment

The ordinary hand buffer or grinder has several disadvantages to the workman engaged in a delicate task. A small motor on the axle of which a buffing wheel or grinder is placed is cumbersome and unwieldy. A new electric buffer and grinder has been brought out which eliminates these disadvantages. The motor is pivoted on a long rod, at the opposite end of which is an adjustable weight. In the center of the rod a hook is placed by means of which the apparatus is suspended from the ceiling. A long flexible shaft leads from the axle of the motor to the buffer, grinder or drill which is used. The workman is merely required to turn on the current by means of a snap socket, and he can devote his entire attention to his work. The speed of this grinder is 3400 r.p.m.

Vulcanizer for Tires

A vulcanizer which will operate successfully on the current from the storage battery of a touring car should appeal to the motorist who likes to do things himself. The "six-volt" automatic electric vulcanizer, as it is called, will do the work of vulcanizing a tire equally as well as the high voltage or the cumbersome gas heated type. Burned or overcured tubes or cases are impossible with this vulcanizer, as the electric current is controlled automatically by a device which increases or decreases the current flow and maintains the temperature constantly at the correct point. The simplicity of operation is one of the most commendable features of the "six-volt" vulcanizer. When the electrical connection is made to the battery a button is pressed and the current flows through the heating coils until the desired temperature is obtained, when the thermostat automatically opens the circuit. This vulcanizer will repair inner tubes and casings up to five inches in diameter.

A Newark inventor has recently brought out a wireless set that can be carried about in a hand-satchel. It weighs but eight pounds complete, and during recent tests it transmitted messages twenty-one miles and received signals over three hundred miles, although the inventor claims that it can be used to transmit messages over three hundred miles under proper conditions. The mechanism proper is enclosed in a case measuring 5 by 8 by 14 inches.



A USEFUL REVOLVING MIRROR FOR THE ELECTRICAL LABORATORY

By William H. Dettman.

A revolving mirror, such as is described here, will prove an instrument of considerable interest to the experimenter who is working with manometric flames, the alternating current oscillograph and condenser discharges. For determining the existence or extent of arcing in the spark gap, wireless operators will find it extremely useful.

The construction of a revolving mirror is not difficult. A wooden base 8½″ long, 7″ wide and ¾″ thick should first be procured. It is indicated by *B* in Fig. 1. Two uprights or standards, *A*, made of wood or rubber, should have the following dimensions: ¾″ thick, 4″ high and a width tapering from 3″ at the bottom to 2″ at the top. Three inches from the lower end of each standard, a ⅜″ hole should be drilled to allow the shaft *S* to project through. Two bearings, *C*, Fig. 3, should be made from 3/16″ x 9/16″ brass strip. These should be fastened to the standards by means of two ¾″ round headed wood screws, the ¼″ hole in *C* being in alignment with the ⅜″ hole in *A*, as shown in the diagrams.

The shaft, *S*, shown in Fig. 3, should be made from a ⅜″ steel or brass rod, 8″ long, the ends of which are turned down in a lathe to a diameter of ¼″. At one end, the length of the turned portion should be 2¾″, and at the other end, ½″. The rod adjacent to the turned parts should be threaded for ½″ to fit a ⅜″ hexagonal nut.

The ends *M*, of the mirror frame, should be made from mahogany or white pine according to the dimensions given in Fig. 3. In the exact center of each square a ⅜″ hole should be bored. These pieces must be made carefully, otherwise the revolutions will not be uniform. Two square pieces, 4″ on a side, indicated by *T* in the drawing, should be cut from the same kind of wood being used in the squares, *M*. They are intended to hold the squares, *M*, together. They should be fastened with 1″ flat head wood screws to the edges of *M*. The screw heads should be countersunk. This will result in the ends of the mirror frame being 4″ square, while before they measured only 3½″x4″. In fact, the frame will take on the appearance of a cube with two open faces 4″ square. Eight pieces of brass or aluminum 1/32″ thick should be cut and bent to conform with the dimensions of *D*, in Fig. 3 3/16″ holes should be drilled as shown in the drawing.

Four pieces of glass mirror, 4″ x 4″+*d*″ (the value of *d* being the thickness of the glass), should be obtained from an art store. The value of *d* may vary between ⅛″ and 3/32″, but not beyond those limits. The mirrors should be held to the cubical frame by angle pieces *D*, which are fastened to the ends *M* by ½″ round head brass screws. This is shown in Figs. 1 and 2. The mirrors should be fastened to the frame in such a way that the longitudinal edge of each one screens

the remaining edge of the consecutive one. This will be clearly understood if the drawing *Z* of Fig. 3 is consulted.

The metal and wooden parts of the mirror, as well as the base and standards, should be given several coats of black shellac.

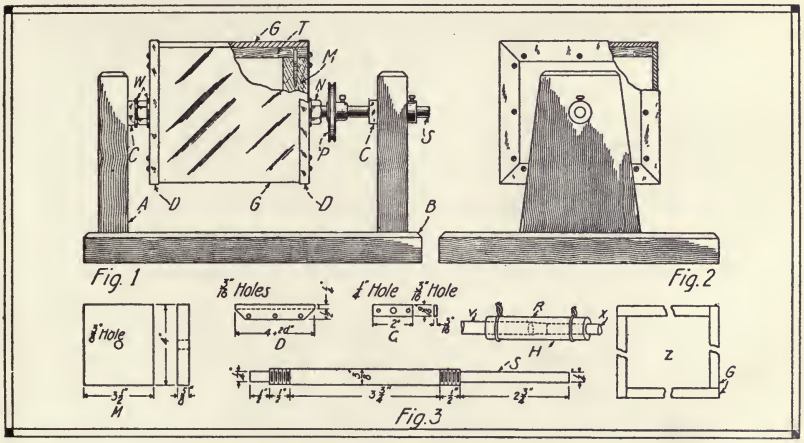
To assemble, the shaft *S* should be passed through the ⅜" holes in the ends, *M*, and a ⅜" iron washer slipped over each end after the hexagonal nuts, *N*, are in place. A pulley, *P*, about 1½" in diameter with a bore of 1¼" should be placed on the end of the shaft and fixed by means of a small set-screw.

Before mounting the mirror on the base it should be balanced by placing the two ends of the shaft on two horizontal knife edges. If the box is ill-balanced, several 3/16" holes should be drilled in the ends, *M*, and filled with lead. An accurate balance, however, is not essential unless the mirror is to be revolved at a high speed.

The mirror should be mounted on the base by means of the two standards, *A*. End play of the shaft can be eliminated by adjusting the washers, *W*.

When the mirror is employed in connection with manometric flame experiments, the shaft should be vertical. An electric motor provides the steadiest power, and its speed can be easily made variable.

In conjunction with an alternating current oscillograph, the motor must be of the synchronous type, so that synchronism is obtained with the mirror. This condition can be arrived at by mounting the motor and the mirror with shafts in alignment and nearly touching. If the shafts are of the same diameter, a short piece of rubber tube should be forced on each end, as shown by *H* in Fig. 3. *V* represents the motor shaft, *X* the mirror shaft, and *R* the tubing. If the shafts are not of the same diameter, the tubing must be large enough to fit the larger one. Rubber tape should be wrapped around the smaller shaft until a diameter equal to the larger one is obtained.

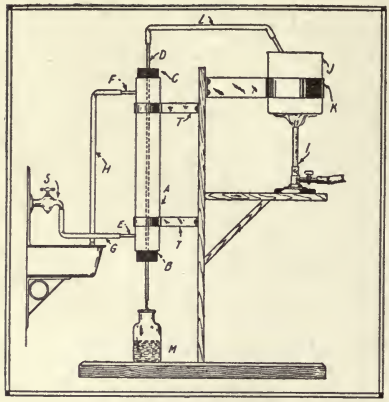


To Soften Paper for Tubes

Paper or cardboard tubes for use in loose couplers, etc., can be made if the cardboard is first softened. Two good ways to soften stiff cardboard are, first, draw the board across a broom handle which is nailed to the end of a work bench, so that a couple of feet project out; second, dip the pasteboard in warm water until the proper consistency is obtained.

Contributed by

CHARLES REYNOLDS.



A Still for the Chemist's Laboratory

Accurate chemistry demands pure materials, and considering the quantities in which water is used, an abundant supply of chemically pure water is indispensable. Distilled water is the purest obtainable, and a still of some sort should form part of the equipment of every well-fitted laboratory. In the accompanying drawing a distilling equipment is shown which can be constructed quite easily and cheaply.

A section of galvanized spouting, 18″ long and 2½″ in diameter, should be procured. Both ends of this tube should be closed with wooden stoppers, *B* and *C*, 2″ thick. Through the centre of both stoppers, holes should be bored to admit the passage, snugly, of ¼″ iron pipe. The iron pipe, *D*, 28″ in length, should be passed through the stoppers so that the ends of tube *A* are equally distant from the ends of the smaller one. A ¼″ hole should be bored ½″ in from either end of *A*, and over them soldered 1½″ sections of ¼″ tube, *E* and *F* for the cold water circulation.

The condenser should be fastened in an upright position by iron bands, *TT*, similar to *K*, to a strong board. Hydrant water should be passed from the faucet, *S*, through the rubber hose, *G*, into *A*. When the tube is filled, water escapes at *F* by way of *H* to the sink.

A large bunsen burner, *I*, should be placed under a gallon tank, *J*, from which a spigot leads. A rubber tube, *L*, should be used to connect this spigot to pipe *D*.

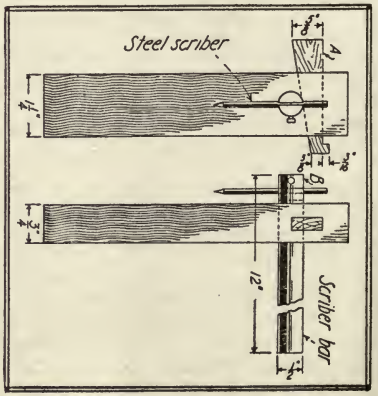
When the undistilled water in the tank is heated, steam arises, which passes through the tube *L* into tube *D*. The running water in the outer jacket cools and condenses the steam into water which drips down into the receptacle *M*. For very accurate results, such, for instance, as are desired in quantitative analyses, the water should be distilled several times.

Contributed by WM. WARTHEN.

Unique Distance-Marking Gauge

For gauging lines on a plane surface, the ordinary marking gauge answers very well, but if the necessity arises to gauge a line parallel to an edge, and between the gauging line and the gauging point a raised portion exists, the ordinary gauge is useless. To overcome this difficulty, the distance gauge shown in the accompanying drawings was devised, and with it, a line may be gauged on the inside of the bottom of a drawer, parallel to any of its sides. As the scriber bar is round, it can be swung in either direction and clamped, so that points can be reached that would be impossible by any other method.

The stock should be made of hard wood, bored to receive the scriber bar. The scriber bar should be ½″ in diameter and twelve inches in length. The



clamping device should be made of hard wood, 5/8" wide, 1/4" thick and 2 5/8" in length. It should be wedge shaped, with a projection on the small end which allows the clamping pin to be inserted when the scriber bar is removed, but when the scriber bar is inserted, the pin is held in place.

The scriber can be made from a discarded round file, and is held in place in the same manner as in the ordinary marking gauge.

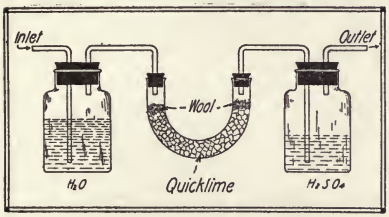
The main advantage of this type of distance gauge, or "Monkey Gauge," as it is called, is that it may be adjusted to any distance by using only one hand, thereby allowing the other hand to be free.

Contributed by

F. B. FALKNER.

A Gas Drier for Chemistry

Experiments in chemistry often require some form of apparatus which will



dry gases. Ordinary drying "set ups" are often dangerous, due to the generation of an explosive gas, and to obviate the possibility of an explosion a somewhat more complicated drier than is ordinarily used, should be employed. The outlet tube from the gas generator should be attached to a bent glass tube, marked "inlet" in the drawing, which leads into a bottle of water. From the wash bottle, another tube should lead to a U-tube into which is packed quicklime with a small tuft of wool placed at either end. From the U-tube the gas passes into a bottle filled with sulphuric acid. This arrangement results in clean, dry gas with no possibilities of an explosion.

Contributed by

W. S. ZEHRUNG.

Cutting Tops from Bottles

The top of a bottle or fruit jar can be cut off very easily by wrapping a strip of moistened asbestos just below the section to be removed, holding it over the flame of an alcohol lamp and rotating it constantly. When the glass has become quite hot, the bottle should be plunged into the water, neck down, and the glass will split off evenly near the line of the wet asbestos.

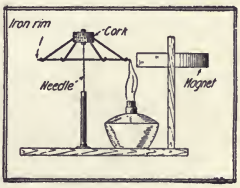
Contributed by

C. H. PATTERSON.

An Interesting Experiment in Magnetism.

The action of this motor depends altogether upon the heat rendering the iron of the rotor non-magnetic, and the attractive force of the magnet for the coolest part of the rotor. Inasmuch as the torque is small, the friction must be very slight, and for that reason the rotor should be of small size—not over about three inches in diameter—as light as possible, trued and well balanced.

The rotor may be made by using a cork for the hub, in the center of which is a bearing, made by drilling a small hole into the end of a piece of hard non-magnetic metal, such as brass. The hole in the bearing fits over the end of a needle, which may be supported as shown in the accompanyiny drawing.



The spokes must be made from some non-magnetic metal, and they should be of as small a size as will rigidly support

the rim, so as to conserve as much heat as possible on the rim. Copper, brass or aluminum may be used. They should be held in place by sharpening one end of each and pushing it well into the cork. The other ends should be bent into a small hook to hold the rim securely in place.

The rim of the rotor is made from soft iron wire, not larger than No. 24, and for good results should be as nearly perfectly round as possible. The ends may be secured by filing the inside of one of the hooks flat and then squaring the ends of the rim, and "butt ending" them in this hook, or they may be welded electrically.

The magnet is so placed that one of its poles acts upon that point of the rim directly over the flame shown in the figure. Any non-sooting flame may be used. An alcohol lamp is excellent and should be so placed that the rim is in its hottest part near the point of the flame.

Upon the action of the rim heated by the flame reaching a bright red heat, it is rendered non-magnetic, and another part of the rim is drawn into the flame, to be heated.

A little experimenting may be necessary in order to determine the exact position of the magnet at which the best results are obtained.

The fact that the iron becomes non-magnetic under the action of heat is possibly caused by the heat accelerating the molecular motion within the iron and thus not only destroying the induced magnetic force, but rendering that part of the rim non-magnetic.

Contributed by

CHAS. E. MULLIN.

A SIMPLE WATER MOTOR

By Ray F. Kuns

There are many uses to which a good water wheel may be put, among them the operating of dynamos, washing machines, emery grinders, jig saws, small lathes and other light machinery. It is a cheap and reliable form of power. The ingenious worker will find much pleasure in the construction of this motor as well as in its use.

CASE: The box or case is made up from any wood which may be at hand, the kind does not matter particularly. Needless to say the joints should be closefitting. The used water is allowed to escape by falling into the sink through the bottom, which is left entirely open for this purpose. In case it is desired to use the motor where there is no sink or waste pipe, the sides of the case should be left as long as the legs and the bottom closed tightly; a drain pipe being attached to take away the water.

Either screws or nails are used in assembling the case. Leaky joints, if encountered, may be remedied by tacking strips of tin over them. Paint inside as well as out.

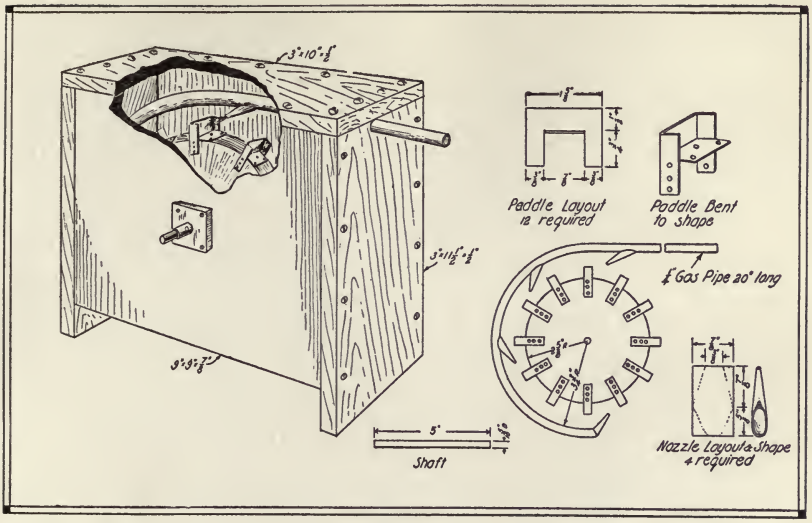
WHEEL: This is made from a piece of ⅞" lumber. If a lathe is available turn up the wheel on it, otherwise lay off with dividers and work to line.

To prevent the wood wheel from warping, the sides are covered with discs of tin which are soldered to a strip of the same metal covering the edge. This excludes all moisture from the wood as well as materially strengthening the wheel.

Drill the hole through the center of the wheel with the 5/16" bit, being careful to have the work exact.

SHAFT: Cold rolled steel is best for this part, but in case it is not available, brass or iron rod may be used. Place the shaft in the wheel and solder securely in place. The shaft should be long enough for a pulley on each side of the case.

PADDLES: These are best made from heavy tin, as it is easily soldered. Note



layout on drawing. Cut and bend these to shape after which they may be tacked in position on the wheel with small brads. When all are in position, solder the edges.

Bearings: Tack a piece of tin 2" square over the center of each side of the case. Drill a 7/16" hole in the center of each of these pieces and on through the side of the case. Enlarge the inside ends of these holes until they are at least ½" in diameter and come back almost to the tin. This is to prevent the bearings binding in case the sides of the case warp.

A piece of 7/16" brass tubing of No. 16 gauge and 1¼" long is now placed in each side of the case. The inside diameter of this tubing will be found very near 5/16". If it is a little tight for the shaft, first drive it on with a hammer and then lay on the anvil and pound it as it is turned. This will soon stretch the brass tubing sufficiently.

Assemble case temporarily, seeing that the wheel is in the center of it when the bearings are soldered to the tin. Drill oil holes when the case is taken apart for further work.

Nozzles: To increase the power of the motor four nozzles are used instead of one. First bend up a piece of gas pipe as suggested in the drawing, after which the holes for the nozzles are laid off and drilled with the ¼" bit. If no drill is at hand, these holes may be filed to size.

Next lay out the tin for the nozzles and cut on the dotted line. Bend these to shape, soldering them at the joint. When the nozzles are finished they may be soldered over the holes in the gas pipe. The opening in the end of the nozzle should be just ⅛". File the pipe clean and tin it before attempting to solder on the nozzles.

Place the pipe in the case around the wheel, making sure that the paddles just clear each nozzle. Wire it in position at the top and back to hold it securely.

Faucet Connection: Wire a short piece of ½" hose on the open end of the gas pipe. Secure the other end of the hose to the faucet by means of a screw connection, the two parts of which may be secured at the hardware store. If the faucet already has a threaded end, the inside part of the connection will be unnecessary, but if the faucet has a plain opening this part may be soldered to it.

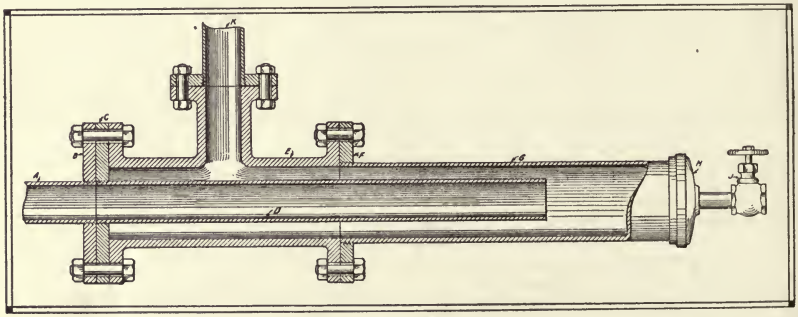
When the wheel is working well the

pulley may be fastened in place and turned true while the motor is running. This is a very simple operation. A rest is provided for the chisel, just as in lathe work, and in a little while the pulley can be finished up neat and true, either with a flat, crowned or grooved face. The pulley should be made from wood or babbitt metal and of a size to suit the individual requirements of the builder.

BELTS: Round belts may often be secured from old sewing machines or made by drawing a square strip of leather through a leather punch or drill hole. Flat belts can be made from bicycle tape by winding several layers of it around the pulleys, thus having the belt endless.

Steam Separator from Pipe Fittings

The object of a steam separator is to remove the condensed steam or water from the pipe line and to permit the live steam to pass on unimpeded. In the drawing is shown the details of a very practical steam separator which can be made at little cost from standard pipe fittings.



Pipe *A* is the main line pipe leading to the device and threaded into the flange *B* which is in turn bolted to the end of a tee *E* but separated from the tee by a second flange of similar size *C* carrying an extension of the main line pipe *A*. The extension is lettered *D*. The tee *E* must be large enough to accommodate the area of the pipe *D* figured from the outside plus the area of the main line or a little larger. The side outlet is to be of the same size as the main steam line. The pipe and flange *F* and *G* are to be of the same size as the tee. The cap *H* is to be fitted with a drip valve *J*.

The steam enters through pipe *D* and after leaving this pipe it turns upward to outlet *K* leaving all water to drop to the bottom of separator to be drained through the valve.

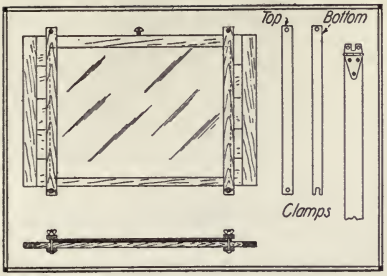
The use of a separator of this kind in connection with a steam radiator will prevent the annoying rattle and bang of the "water hammer" by preventing water from entering the radiator.

Contributed by

HARRY A. SCHREIBER.

Printing Attachment for Drawing Boards

For the amateur draughtsman to whom hand printing is still a difficult art, a printing attachment for his drawing board will be of considerable help. Clamps should be made of yellow pine strips 1″ x 2″ of a length sufficient to outreach the length of the drawing board by about 1″. They should be held together by ¼″ bolts of suitable length, fitted with wing nuts for quick adjustment. A blanket of light felt should be placed upon the board to compensate for any ir-



regularities that may be present, and to prevent the breakage of the sheet of glass that is used.

Contributed by

V. A. BLOXHOLM.

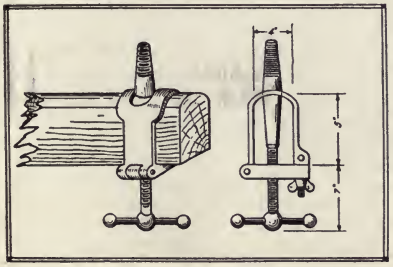
To Remove Insulator Pins

The experienced lineman knows the difficulty of removing insulator pins that have become useless either by being burned off or by the thread having become worn down to a point where it will no longer hold the insulator. The conventional method of hammering the old pin out frequently results in damage to the other insulators on the cross arm.

In the illustration is shown a simple but very effective little tool to assist in the removal of such pins. The construction is shown clearly in the drawing and the reader will note that the device consists merely of a U-shaped band with a pivoted yoke carrying a long screw with a substantial handle on its end. The U piece is slipped over the pin and cross arm as shown, the yoke secured and the handle turned so that the screw forces the pin up and out of the cross arm.

Contributed by

F. W. M.



Non-spilling Flux Bottle

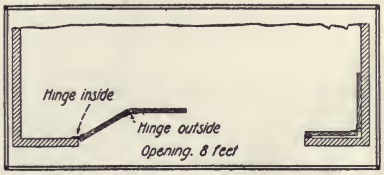
If a wad of cotton batting, large enough to absorb the liquid, is placed in a soldering flux bottle, the constant danger of the bottle tipping and spilling out its contents is easily prevented. The flux should be applied to the joint with a small brush. Plenty of liquid is taken up by the brush from the soaked batting.

Contributed by

J. G. LUNDHOLM.

Collapsible Garage Door

Small garages do not afford enough space, ordinarily, for sliding doors or even swinging doors of the usual type. By the use of a folding or collapsible door, which swings and folds up out of the way in the corner, the difficulty can



be gotten around nicely. The first sections should be hinged to the door jamb, and the second hinged to the outer edges of these.

Contributed by

MERT. MARSILLIOT.

Black Ink

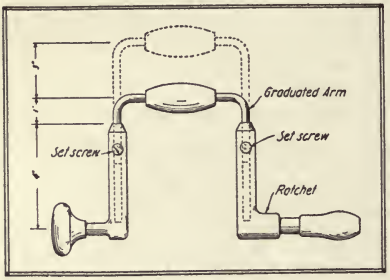
Two and four-tenths grams of logwood extract should be mixed with one hundred cubic centimeters of distilled water. Heat should be applied until the substance is dissolved. After it is cooled, potassium chromate should be added until the desired shade is obtained. Too small an amount results in a purplish blue, while too much causes a dead black. From 2 to 3 c. c. are usually sufficient. A little gum arabic or gelatine may be dissolved in the solution to give it "body." If this is done the solution should be filtered through silk.

Contributed by

W. S. ZEHRUNG.

Adjustable Handle for Brace

The illustration shows a bit brace made with an adjustable handle so arranged that the length of handle, or in other words the leverage, can be changed to suit the conditions of the work at



hand. This tool will be found exceedingly useful to the building trade.

While the illustration shows the brace as made with a special casting or forging, the ordinary brace could easily be altered through the exercise of a little ingenuity to combine the advantages of that shown in the drawing. The section of the handle frame inserted into the sockets should, of course, be square in order that the brace may be firm when in use.

Contributed by

WM. J. ALBIN.

How To Cement Glass

Two good formulæ for cements to mend glass are given below:

Pulverized glass	10 parts
Powdered fluorspar	20 parts
Soluble silicate of soda	60 parts

Both glass and fluorspar must be in the finest powder. The mixture should be made by quick stirring and must be used at once.

For mending valuable articles in glass: A strong solution of gelatine to which is added for every five parts of gelatine one part of acid chromate of lime in solution. This mixture becomes insoluble in water under the action of light. The surfaces to be cemented should be covered as evenly as possible with this liquid, pressed firmly together, tied with string or cord and the glass exposed to sunlight for several hours. Boiling water has no effect on this cement and the fracture can scarcely be recognized.

Contributed by

HARRY C. BOYER.

Frosted Glass

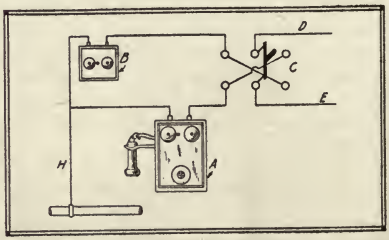
Glass can be treated chemically so that it will have the same appearance and do the same work as ground glass. Ninety grains of gum sardarac and twenty grains of gum mastic should be dissolved in two ounces of ether. One ounce of benzole should be added afterwards. It is essential that the benzole be quite fresh. The solution should be poured quickly and evenly over the surface to be frosted.

Contributed by

GEO. W. GREENE.

A Private Telephone Line

By the use of a double-pole double-throw knife switch, the complicated circuits of the usual private telephone line are eliminated. As indicated in the diagram of connections, *A* is the telephone, *B* is a call bell, *C* is a D. P. D. T. switch, *D* is the party line of the local telephone company, *E* is the private line and *H* is



the ground wire. When the switch is thrown to the right, the telephone is connected in the party line circuit, and the extra bell of the party line will ring. Reversing the switch throws the telephone on the private line, and the party line bell is also connected to ring.

Contributed by

C. L. CHRISSINGER.

SEWAGE DISPOSAL FOR COUNTRY HOMES

By H. W. Young.

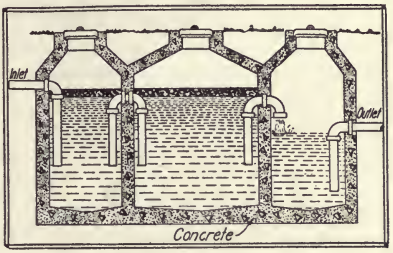
Scientists have proved by experiments that sewage will become purified and rendered entirely harmless if allowed to remain in a tank where a certain sort of "friendly bacteria" eat up or destroy all poisonous matter. Indeed, this method is employed on an extensive scale in the sewage disposal plants of large cities.

As an adjunct to the water supply systems which many farmers and owners of summer homes are now installing, it is desirable that some form of sewage disposal be installed also.

A cheap yet effective "septic tank" or receptacle is shown in the diagram. The receptacle may be located at any convenient point, but not beside an open well. The inlet pipe should be three to four inches in diameter, laid below the freezing line. The walls of the tank should be of concrete four to five inches in thickness, and one, two or three compartments may be provided. The depth below the inlet pipe should be five to ten feet, and the first compartment large enough to contain 24 hours' accumulation of sewage.

One compartment is sufficient for ordinary family use, but two are better as the bacteria have more chance to consume the solid matter and purify the liquids before they leave the tanks.

Three compartments should be constructed for hotels, country clubs, etc., and where only one or two are used the outlets should be put in as shown. The outlet may be conducted to a low point or may be carried only a short distance



to a filter bed. A pit measuring four feet square and six to seven feet deep filled with gravel, crushed stone or cinders will make a good filter. The filter bed is only necessary where the ground is very heavy black soil or clay, too solid to allow the liquids to escape. Any plumber will understand how to put in the necessary traps in order to prevent poisonous gases from entering the house from the sewer pipes.

To Insulate Small Punchings

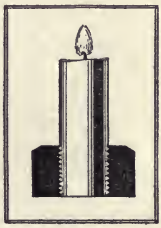
Small punchings for motor armatures or other electrical apparatus can be insulated quickly and easily by dropping them into a bottle containing shellac. They should be stirred thoroughly so that they are entirely covered, and removed and strung on a thread in the open air. When they are partly dried, the line should be shaken in order to remove the surplus liquid. For best results, the shellac should have the consistency of thin oil.

Contributed by

CLARENCE H. ANDERSON.

Ingenious Candlestick

An ingenious substitute for the untidy method of sticking a burning candle to a shelf or ledge by melted wax, is to screw the candle into a heavy burr. Such an improvised candlestick prevents upsetting, and the candle can burn down and out without danger of fire.



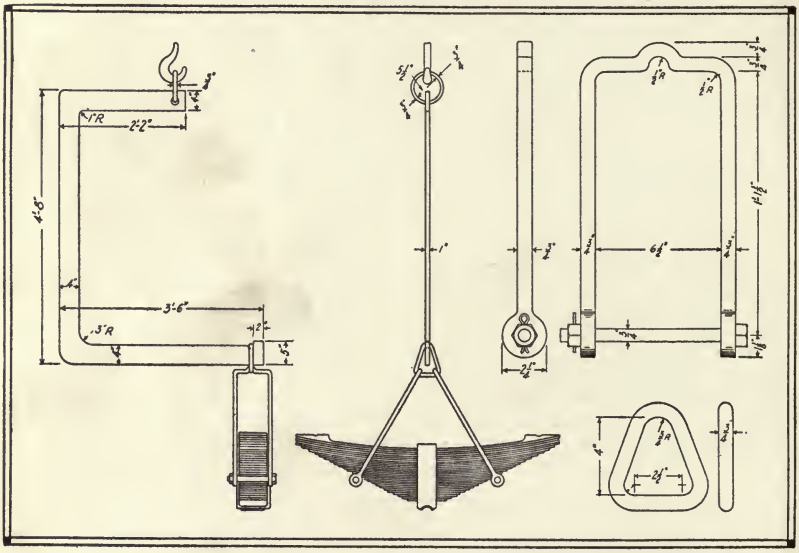
Contributed by

J. E. LUNDSTROM.

Lifting Machine for Locomotive Springs

Although a machine for lifting the springs of a locomotive in place will probably not fall within the scope of interest of most of our readers, the idea in itself is novel and original, and may suggest applications to commoner use.

A crane or air hoist is attached to two hangers which are placed under the spring. They terminate at the upper end in a triangle of iron rod or steel, at the apex of which is attached a long bar with a hook at the other end. This hook



fits in a ring which is hung upon the crane hook. The various parts are shown in detail in the accompanying drawing.

Contributed by

JOSEPH K. LONG.

For Fountain Pen Users

If the threaded piece of a fountain pen is lightly greased with vaseline, the parts will unscrew more easily, and the ink cannot leak out.

Contributed by

GEORGE W. GREENE.

Removing Stains of All Sorts

Almost any stain can be removed in some way. A few remedies for common stains are given below.

Acid stains may be removed in almost all cases by ammonium hydroxide, commonly known as household ammonia. An aqueous solution of baking soda may also be used.

As for analine dyes, an aqueous solution of sodium sulphite will immediately remove the stains of most analine dyes from the hands.

Ink stains and iron rust may be removed by a concentrated solution of pyro phosphate of soda or oxalic acid. The latter should only be used on white cloth.

Mildew can be taken off with a weak solution of chloride of lime or calcium oxychloride and exposure to sunlight.

Silver nitrate and chemical ink stains can be removed by using a solution of bichloride of mercury. *This substance is very poisonous and should be handled carefully.* In the case of fresh stains a weak solution of potassium cyanide produces good results. Like the other, however, it is a dangerous poison and should be used with caution.

Paint stains may be taken out with carbon disulphide, chloroform, or spirits of turpentine. Care should be taken that none of these substances is brought near an open flame.

Tar stains can be removed by first applying olive oil freely. When the tar is soft, turpentine, naphtha and benzine should be applied successively. Strong alcohol will usually remove these stains as well as those of beeswax, resin, and the like.

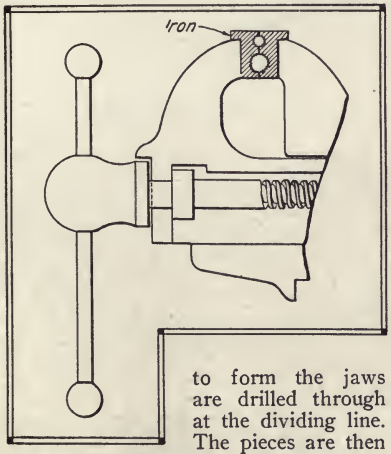
All of these stain removers should be applied carefully and when liquids are used a blotter should be handy for the purpose of absorbing the surplus solution.

Contributed by

W. S. Zehrung.

Pipe Vise

The illustration offers a suggestion for a simple attachment in the form of special jaws by means of which any bench vise may be adapted to take pipe in various sizes. The attachment may be made from a pair of iron castings or planed up from pieces of steel. When the general form has been secured, the two sections are gripped together in a pair of clamps and the holes which are



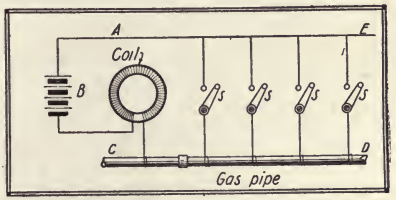
to form the jaws are drilled through at the dividing line. The pieces are then separated and the teeth of the jaws may be filed in the faces. The scheme of having two holes in each pair of jaws lessens the number of sets required, but it prevents the firm grip obtainable with but one hole placed in the center of the attachment.

Contributed by

Frank Harazim.

A Multiple Electric Gas Lighter

Lighting the bunsen burners along a laboratory table by electricity saves both time and matches, and the cost is com-



paratively low. A small inductance coil of the "make-and-break" type and a set of either wet or dry batteries are required. The coil consists of an iron ring 4″ or 5″ in diameter around which is wrapped 500 turns of No. 25 D. C. C. magnet wire. From the batteries, *B*, one wire, *AE*, should be run. The gas pipe, *D*, will suffice for the return circuit. Short wires should be connected from *CD* and *AE* and lead above the gas jet. Switches, *S*, should be inserted to prevent short circuits.

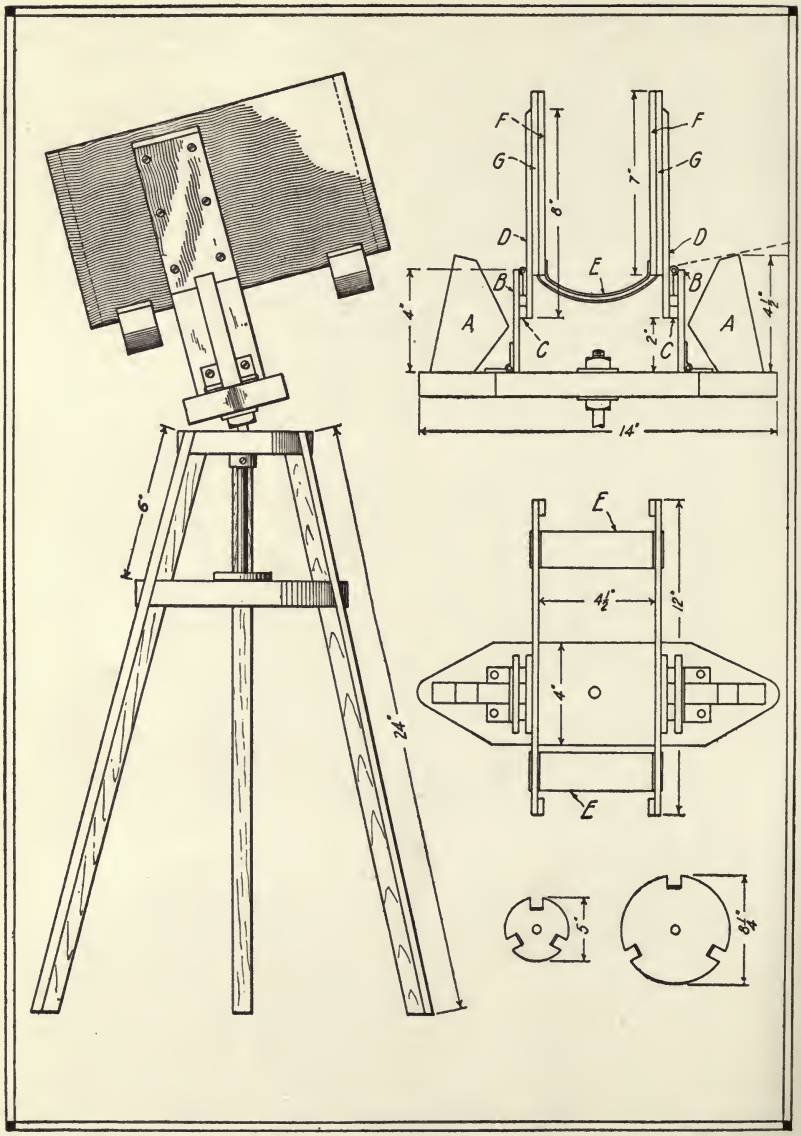
Contributed by

Hiram W. Edwards.

Dictionary Holder

A dictionary holder that requires no springs and can be made of odds and ends about the workshop is shown in the accompanying drawings. The dimensions given are for a dictionary of the standard size, 4½″x8″x11″. If a dictionary thicker than 4½″ is used, it will be necessary to place the hinged supporting pieces farther apart than shown in the drawings.

Slots should be cut in the boards which are to cover the sides of the dictionary, and bands or tapes, *E*, for supporting the book should be passed through the slots



and sewn together so that they will hang down loosely and fit the binding.

As shown in the end view, the odd-shaped pieces, *AA*, are higher than the

hinged pieces *BB*, so that when the book casing is open, it will rest in a sloping position on the pieces *AA*, as indicated by the dotted lines. It should be noted that the small pieces *CC*, are of a thickness equal to that of the folded hinges and nailed or glued across the ends of pieces marked *DD*.

A bolt, ½″ in diameter and of sufficient length that 8½″ remain after the head and square shoulder are cut off, should be obtained. The sharp edges made by cutting the bolt should be rounded off with a file. At the point at which the thread ends, the bolt should be bent at an angle in order that the book-casing will be supported in a sloping position as shown in the side elevation. Two nuts and two washers are required. The bolt should be held in a vise, and the first or lower nut screwed tight at the end of the thread. The lower end of the bolt enters and turns in a hole in a small circular piece nailed to the lower 8¼″ plate.

An iron collar having a set-screw is fitted to the bolt beneath the 5″ top plate of the tripod. This arrangement is not necessary, however, if care is taken in lifting the book-holder by grasping the tripod rather than the book-casing.

An ornamental button may be turned to cover the upper nut of the bolt, if desired.

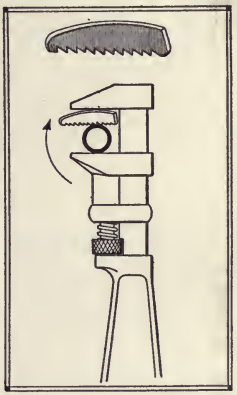
Contributed by

C. H. PATTERSON.

A Vest Pocket Pipe Wrench

Mechanics do not ordinarily have sufficient call for a pipe wrench to require one as a part of their regular kit; yet, occasionally, a demand is made in the form of a pipe that must be tightened, or a stubbon rod that cannot be turned, by the ordinary monkey wrench. A supplement for a monkey wrench which will serve it for tightening pipes and rods is shown in the accompanying illustration. It consists of a small bar of steel 1½″ long, ¾″ wide and ⅜″ thick. The back should be curved so that it will be self-adjusting. The face, which is straight, should be cut with saw tooth notches across the entire width, and hardened.

To use the improvised pipe wrench the notched piece should be inserted in the monkey wrench between the jaws, not quite touching the shank. The wrench should be opened far enough to admit the pipe which rests opposite the "hump" on the attachment. Turning the wrench in the direction of the arrow will cause the pipe to roll in toward the shank and allow the teeth to gain a secure hold. This arrangement will tighten a right-hand thread, while the same pipe can be loosened by placing the attachment on the lower jaw of the wrench and turning the handle in the opposite direction. The attachment will fit practically any sized wrench, and it is adapted to a wide range of diameters.



Contributed by

W. H. SARGENT.

Pewter Color in Brass

A color closely resembling pewter may be given to brass by boiling the article in a cream of tartar solution to which has been added a small amount of chloride of tin.

Contributed by

HARRY C. BOYER.

To Repair Old Carpet Sweeper

When an old carpet sweeper refuses to work, an examination will often show that it can be repaired quite easily.

If the rubber tires of the wheels are loose, they should be removed, soaked for several hours in boiling water and dried. This will contract them, so that they fit tightly. Thick shellac should be used to cement them.

The drive pulley which is usually an integral part of the brush spindle, may be worn down to such an extent that the rubber wheels do not bear upon it. It should be whittled down to the size of the spindle. Next, a block of tough wood in which a hole is bored to fit the spindle, turned in a lathe or whittled round to the right size, is glued on the spindle.

If the machine still refuses to work, although the brush revolves, the trouble probably lies in the fact that the brushes have been worn down to such an extent that they do not touch the carpet. In this case, the screws in the bearings at the end of the brush should be taken out, and the brush lowered about ¼ inch. If some of the brushes or bristles have come out, they can be replaced from an old hair brush.

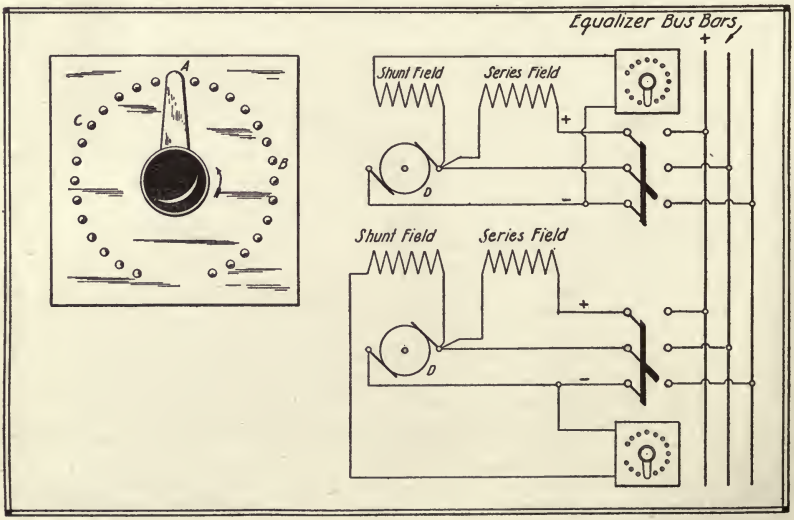
Contributed by Wm. C. Houghton.

RESISTANCE OF CONDUCTORS AT DIFFERENT TEMPERATURES

By William Morton

The writer noted with interest the article in the February number of this magazine by J. H. Blakey entitled "Electrical Resistance at Low Temperatures," and submits herewith a little proof of the theory advanced.

In the power house with which the writer is connected are two 250-K. W. motor-generator sets of the synchronous type, with the generators connected in parallel; that is, both sets are pulling on the same load. The motors are running on 4000-volt, 3-phase current and the compound-wound generators deliver 110 volts at no load while the full load voltage is 125 (direct current). The current supplied by the generators is used by 110-volt motors and lamps, and in order to maintain the voltage, the latter is adjusted to 115 volts at the



power house and the machines are balanced so as to deliver that potential with the aid of the rheostats indicated in the sketch.

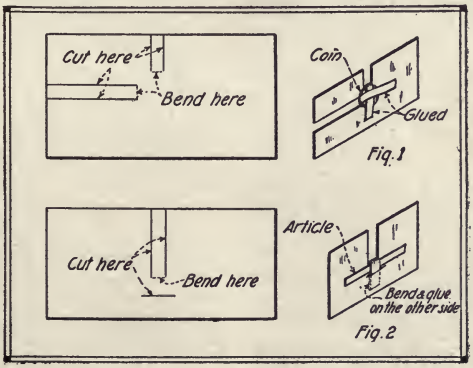
During the cold weather (the temperature dropped to zero outside) the heating system failed for two nights and in starting the machines each morning it was found that with all the resistance in circuit, the voltage was 120, while the same point on the rheostat, had the resistance been warm or of normal temperature, would have cut the voltage down to 100. As the rheostats heated up with the current, the voltage gradually lowered and after about 30 minutes the voltage was 115 and ten minutes later the rheostats had to be moved to their balanced point.

A further test was made in which No. 1 machine was started and run on full load, the voltage being just as described. In 40 minutes No. 2 machine was started and thrown in, together with No. 1, on full load with the result that the voltage of each was 120 with No. 1 rheostat (warm) as shown at *C* and No. 2 rheostat (cold) as shown at *B;* the difference in points on the two rheostats proving necessary in order to equalize the load between the two. In half an hour the two machines were perfectly normal and the voltage of each was 115 with the rheostat lever at *A*. When the operation of the heating system was resumed on the following day the trouble disappeared entirely.

While the above seems to be a practical illustration of the effects of low temperatures on the resistance of metals, still the writer is of the opinion, based on experiments, that the resistance of the liquid in a water rheostat decreases with an increase of temperature instead of *vice versa,* as in the case of the metallic resistance.

To Mail Coins

Two suggestions for mailing coins and other articles too heavy to permit of their being placed loosely in an envelope, are given in the illustrations. Both mailers involve the use of a minimum amount of cardboard which is first cut exactly to fit into the envelope. Fig. 1 shows the coin mailer and Fig. 2 the card to take an article of some length. If so desired, several holding strips can be cut in the same card. If no paste is available, the ends of the strips may be held with pins.



Money mailed in the manner described is not liable to be lost.

Contributed by

N. G. Near.

Written Stereopticon Slides

During one of the recent elections, a newspaper editor, who wished to give the returns to the crowds by means of a stereopticon, found that there were no blank slides in the office. Various substitutes were tried without much success until the following plan was hit upon.

A sheet of celluloid was purchased from a carriage builder and cut into pieces 3x4 inches in size. On either side of the piece of celluloid was placed a sheet of the softest carbon paper obtainable, and the three sheets were inserted in the typewriter. The election returns were then typed, and the results were very satisfactory. The carbons made a

clear impression on the transparent celluloid, and the resultant view on the screen was quite readable.

When the returns had been seen by all those in the street below, the printed celluloid was removed from the stereopticon frame and cleaned with a damp cloth. In this way one piece of celluloid could be used repeatedly. A good way to mount the celluloid when it is put in the projecting machine is to place it between two pieces of glass, fastened together with a hinge made of adhesive plaster, such as can be obtained from any druggist.

Contributed by

CHARLES M. STEWART.

An Emergency Radiator

The following experience with a broken auto-truck radiator, and the emergency radiator which was substituted, will be of interest to motorists.

The writer, while driving a motor-truck, met with an accident which caused the radiator to leak so badly that it would not hold enough water to cool the engine. No repair shops were convenient, so an old whiskey barrel, which was handy, was placed in the truck behind the seat, and a ¾-inch hole bored near the bottom. A piece of ordinary garden hose was driven into the hole and connected to the intake water pipe of the engine. Another section of hose was run from the discharge to the top of the barrel. With this makeshift repair, a run of twenty miles was made with the engine quite cool.

Contributed by

J. C. WOODMAN.

Ingenious Dark Room Lamp

A good substitute for a ruby lamp for a dark room can be made by dipping an electric light bulb into red analine dye which is thoroughly mixed with gelatine and water. The light should be turned on, as the heat quickens drying.

Contributed by

RUSSELL WALDO.

Substitute for Hot Water Bottle

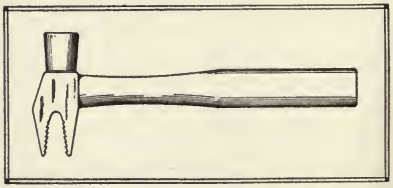
A very simple substitute for a hot water bottle is suggested by a Californian doctor. It involves the use of an electric light bulb and ordinary metal reflector. The open front of the reflector should be closed by means of a piece of tin. When this is to be used it should be slipped into a flannel bag to prevent contact of the metal with the skin.

If moisture as well as heat is wanted a wet cloth placed between the skin and the box may be used. This little device is not heavy and has the advantage of maintaining a uniform heat for any length of time desired.

Since there is a possibility of excessive heat being given out by the lamp, care should be exercised. A lamp may be placed in series to cut down the heat.

A Wrench and Hammer Combined

An unique and decidedly handy tool for the man-about-the house is shown in



the accompanying illustration. By the use of a broad angle in which the saw-tooth notches are cut, the tool may be used as a pipe wrench adapted to a fairly wide range of diameters.

Contributions to this department will be paid for at space rates, with a minimum of $1.00 per idea.

A HANDY CANOE LAMP

By Earl C. Swetman

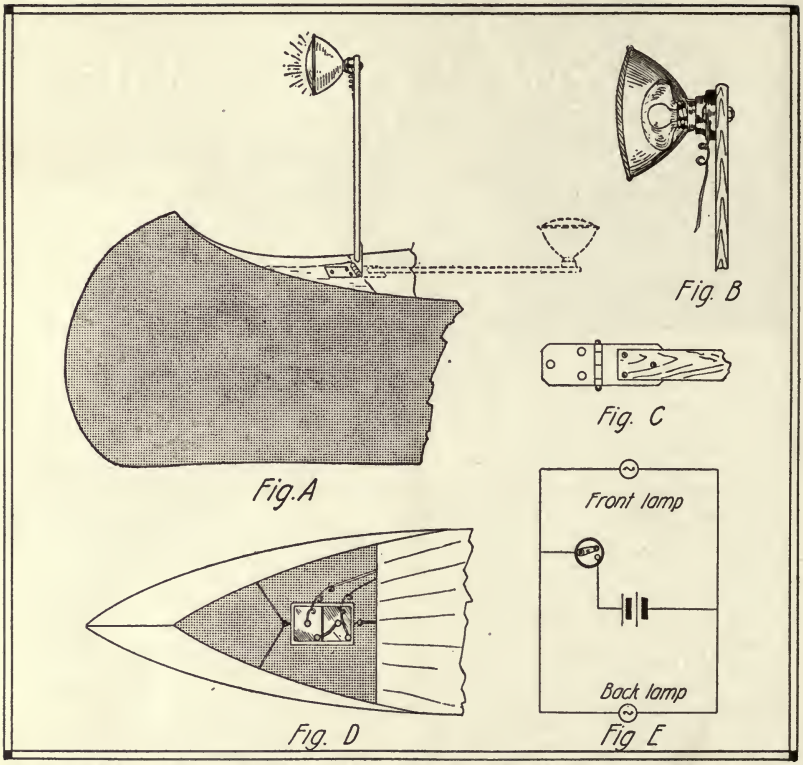
It is rather an exceptional thing to see a canoe carrying lights after dark, although it is just as advisable to show lights from a canoe as from a larger craft. Lights displayed on a canoe serve as a means of protection from being run down by motorboats rather than as a warning to other craft. It is largely a matter of safety, although the convenience of having a light is an inducement in itself.

A novel and simple way of installing electric lights on small craft is to have them so arranged that they may be elevated to a conspicuous position when required, and lowered to a safe and out-of-the-way position when the canoe is put on the rack. The two positions are shown at *A* in the accompanying drawing. This is done by using an ordinary brass clasp about 5 inches long. One-half of the clasp is screwed to the deck, close to the bow or stern, and to the other half is screwed the flat, wooden stick, which supports the light, as shown at *C*.

The canoe lamp is shown assembled at *B*. It consists of a miniature receptacle, a small reflector and a miniature lamp, all of which may be bought at any electrical supply shop. A three-volt lamp, with a good reflector, is sufficient for the purpose and gives a surprisingly brilliant light. The wires from the lamp can be run down the sides of the supporting arm, and through small holes in the deck, to the battery. Wire of No. 20 or 22 gauge is a good size to use.

One of these lights may be erected on each end of the canoe, and controlled by a switch under the rear seat or wherever desired. In order to save the batteries as much as possible, the lights need be used only when necessary, and turned off when no other boats are near.

The battery for the lamp is placed under the front deck, since the bow is usually out of the water anyway and the cells are best placed there to distribute the weight. They are suspended as shown at *D*, in a very rigid manner. With this arrangement the cells are always kept dry, for should water get into the bottom, they are above it, and when the canoe is turned over and the water runs down on the under side of the deck, the battery is still above the water. The three wires that run from one end of the canoe to the other must be kept dry, and it is advisable to run them through rubber or brass tubing along the keel or under the gunwale. The wiring diagram is shown at *E*, in which it will be noticed that both lights are controlled by the same switch, while two cells of the battery are placed in series.



Various Details of the Electric Canoe Lamp, as Well as a Wiring Diagram for the Connections If Two Lamps Are Used.

The one commendable feature of the electric canoe lamp described is that it in no way interferes with the usual handling of the canoe. When the craft is placed on its rack, there are no projecting parts nor is there anything to fall out. The weight of the entire outfit is insignificant.

PANAMA-PACIFIC EXPOSITION NOTES

PERHAPS the largest exhibit at the Panama-Pacific International Exposition is that installed by the Federal Government. It is scattered about in the eight main exhibit palaces and includes practically every branch of work taken up by the many departmental bureaus.

In the Palace of Mines and Metallurgy there is a section devoted to radium-bearing ores. Here the visitor will see a small building about ten by fifteen feet in size, the walls of which are sheathed with corrugated iron. The one entrance to this structure is presided over by a guard who permits the inno-

cent looking person to enter therein so that he may view five specks of radium salts. The interior is painted a dead black and one small red light serves to give the necessary illumination. Along one wall are five booths and across each booth is a shelf in which the speck of radium salts is incased. A magnifying glass is mounted above the radium to enable the observer to obtain a more detailed view of the radio action of the metallic salts under observation. To the observer the crystals are outlined by a white scintillating light which in appearance resembles an electric brush discharge, while the circumambient region glows with a phosphorescent and aurora borealis effect.

The visitor from New York City will wish to linger at the exhibit of the Pacific Telephone and Telegraph Company in the Palace of Liberal Arts. Upon entering an elaborately furnished room he will be politely ushered to a seat At 4:30 p. m. a lecturer steps to the front, the room is darkened, the motion picture projector is started and an illustrated talk is given on the principles of the telephone exchange and facts about the new trans-continental telephone line. There is a pair of head receivers hung on the back of each seat and at 5:00 p. m. (8:00 p. m. in New York), the lecturer announces that "We will now ring up New York. Place the receivers over your ears and listen," says he. So we clamp the receivers on our head, but hear nothing. "Sometimes there is a delay in making the connection," he continues, "but we usually get them in a few seconds."

In less than a minute we hear the click-click of telegraph sounders amid a conglomeration of voices and then with a final click we "get" New York. "Hello San Francisco. This is New York. Greetings!" says the man in his New York office, whose voice is reproduced so loud and clear that we can understand with the receivers held three feet from our ears. The electric fans are shut off to diminish the noise and the voice from New York continues, "It is a very cold day here," and then reads some news items of the day. He next places a phonograph before the transmitter and for several minutes we are treated to a musical selection. Now comes another click and the spell is broken. Possibly our own impressions are best portrayed by the lady from the country who exclaims as she leaves the room, "My, ain't it wonderful!"

An interesting exhibit in the Palace of Machinery is a 500 H. P. Diesel oil-engine coupled to a 250KW 220V D. C. generator. The engine bears a sign which reads: "At noon Feb. 20th, 1915, President Wilson started this engine by wireless from Washington." The radio-telegraph relay which served to start the fountains and open the doors of the various palaces also actuated a secondary relay which operated a valve controlling the compressed air used to start the engine. The current generated is used by other exhibitors.

The Aurora Borealis has a dangerous competitor in the form of a two and one-half billion candle power electric scintillator which plays its colored shafts of light upon the cloud and fog banks or upon smoke and steam clouds when the former do not exist. This scintillator consists of a battery of forty-eight thirty-six-inch projectors operated by a force of marines who have been trained especially for this duty. The men are divided into sections and squads so that the projectors may be operated in a systematic manner for producing various combination and color effects. A large locomotive stationed nearby generates the necessary steam to be used in the absence of clouds, while hundreds of four- to ten-inch bombs are sent aloft to add to the effect. Red, blue, orange and green disks are placed before the projectors. When these forty-eight magnificent colored shafts of light are played upon the clouds, the visitor is lost in admiration at the beauty and grandeur of this artificial aurora borealis.

The quantities of ammunition consumed and the cost involved in conducting a modern naval fight are stupendous. As an example it is said that the cost of firing all the guns of the big British battleship *Queen Elizabeth* for one hour would be well in excess of $1,000,000.

The Summer Cottage Completed

A CRAFTSMAN SUMMER COTTAGE

Describing a Summer Dwelling that May Be Constructed by the Average Handy Man at Low Cost.*

By Ralph F. Windoes
Instructor of Manual Training, Davenport High School, Davenport, Ia

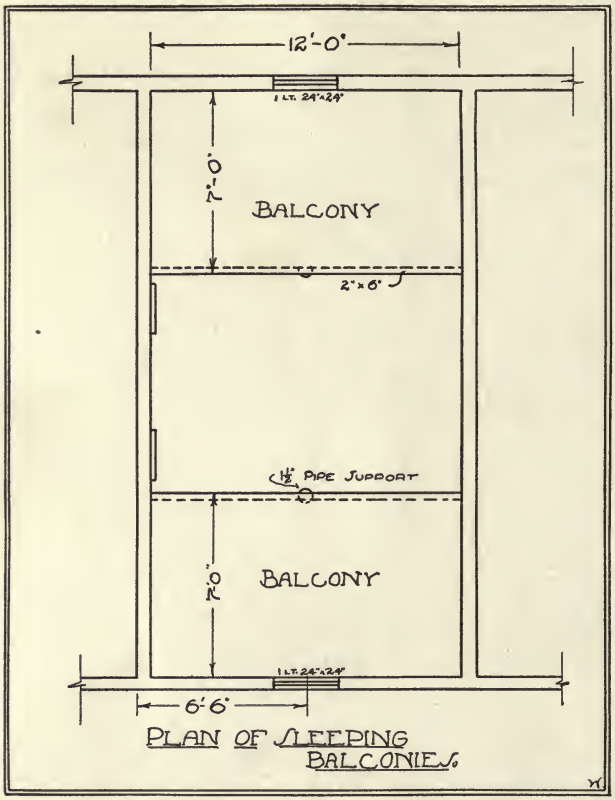
Illustrations from drawings made by the author

WITH the coming of the springtime our good craftsman finds it an effort to stay in his little crafts-shop and construct those useful things that have held and interested him through the long months of winter. The spirit of the springtide—the lure of the woodland with its visions of cool glens and shimmering lakes—enters into the little shop where it entices our craftsman to put aside his tools and go out of doors. Those of us who are human—and all good craftsmen are—have felt this "call of the wild" with its pull to the waters, and we have longed to build us a little summer home where we might spend a few weeks of each year, at least, in the healthy companionship of nature.

But, unluckily, the cost of such a home has made it impossible for a great many of us. We have not the ability, or at least we think that we have not, to build one ourselves, and to have one constructed for us, with the high cost of labor, land and materials, makes it prohibitive.

So, with these things in mind, the writer has endeavored to evolve a little cottage of good design—and comfortable, and in this, and in subsequent articles, he will tell our craftsman exactly how to build the cottage. So fully will the explanations be given that any boy with just his manual training school experience, and any home craftsman who can hammer and saw with a little accuracy, will find no difficulties to surmount if he cares to tackle it. Its cost should not amount to much over $250 for material—this varying according to locality, grade of materials purchased, distance from a railway station, etc. As for the land, he may buy a lot outright or he may rent a spot for a given number of years, with the option of buying it at any time. As an investment, few will pay a higher rate of interest. If he has put, let us say, $400 into it—and this should be ample fully equipped—he should be able to rent it for ten weeks of the summer at $15 a week, and have it for his own use two or three weeks

*This article is the first of a series on the construction of the summer cottage. Additional details will be given in the instalments that will follow regularly in forthcoming issues of THE WORLD'S ADVANCE.



PLAN OF SLEEPING BALCONIES.

besides. In three seasons, it would actually pay for itself. (This figure is based on rents obtained for cottages of this kind at the inland resorts of Michigan.)

The cottage shown in the sketch is similar to that owned by Mr. George S. Waite and built at Comstock, Mich., upon the banks of the Kalamazoo River. It was put up entirely by manual training school students from Kalamazoo under the supervision of Mr. Waite, and from plans designed by the author.

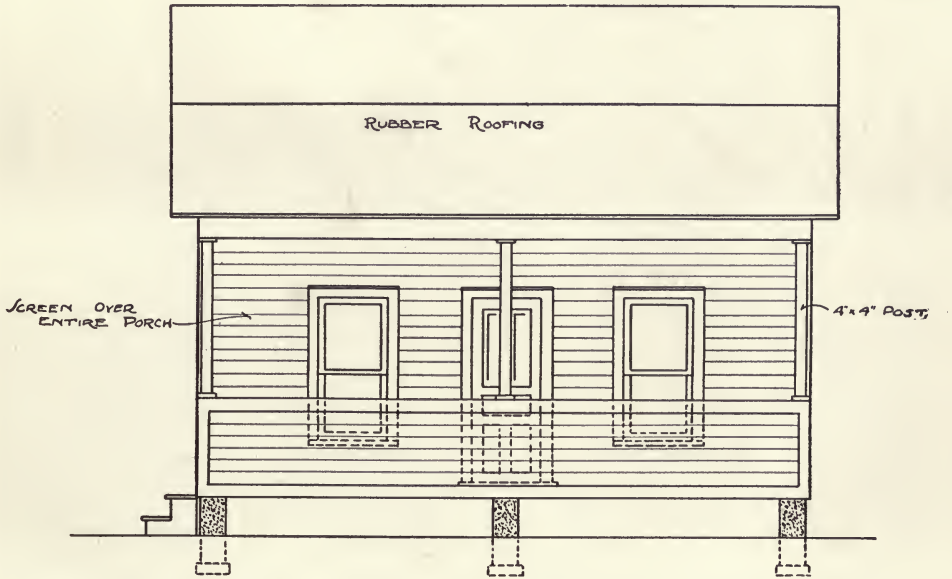
As a careful study of the plans will reveal, it is a wonderful combination of comfort and utility. The large, screened-in porch overlooking the river is the favorite lounging place. It can be used to dine upon, and it offers ample space for cots, if used as a sleeping porch. The living room, as seen on the floor plan, is 12 feet wide and 23 feet long — a large, comfortable, well-lighted room. At each end, and raised a good distance from the floor, are the sleeping balconies. These are curtained off to the height of 7 feet and 6 inches, which effectually cuts off any view to or from them when in use, and they are reached by the means of ladders. Each balcony can easily accommodate four sleepers, and with cots placed beneath them, and also curtained off, a total of ten or twelve people can easily and comfortably be accommodated in the little cottage. The combination kitchen and dining-room, perfectly arranged, completes the plan of the cottage.

An approximate bill of material follows. This has been compiled with great care and, providing full measure is given by the dealer, will fully cover every item needed. The prices given are reliable at the present time in the middle west for the grade of material itemized. If No. 1 stock is ordered, the price will advance about 25 per cent. It is possible to purchase second-hand lumber and millwork, and if the craftsman keeps on the lookout for such, he will be able to cut his expense account down to a considerable extent.

SUMMER COTTAGE.

FRONT ELEVATION.

FOR SCALE SEE "FLOOR PLAN"



BILL OF LUMBER

NUMBER OF PIECES	SIZE OF PIECES	DESCRIPTION	FEET	PRICE PER M	TOTAL AMT.
38	2″ x 6″ x 12′ 0″	Sills and joists, No. 2 Yellow Pine...	456	$18.25	$ 8.32
20	2″ x 6″ x 14′ 0″	Sills, girders and balcony headers, No. 2 Yellow Pine.....	280	18.25	5.11
8	2″ x 6″ x 24′ 0″	Sills and double joists, No. 2 Yel. Pine	192	21.50	4.13
2	2″ x 10″ x 24′ 0″	Porch headers, No. 2 Yellow Pine....	80	24.75	1.98
8	2″ x 4″ x 24′ 0″	Plates, No. 2 Yellow Pine.....	128	25.00	3.20
32	2″ x 4″ x 18′ 0″	Studs and Rafters, No. 2 Yellow Pine	384	22.75	8.73
45	2″ x 4″ x 16′ 0″	Studs and window headers, No. 2 Yellow Pine.....	473	19.25	9.10
6	2″ x 4″ x 14′ 0″	Studs, No. 2 Yellow Pine.....	54	19.25	1.05
20	2″ x 4″ x 12′ 0″	Studs, No. 2 Yellow Pine.....	160	20.50	3.28
26	2″ x 4″ x 10′ 0″	Rafters, No. 2 Yellow Pine.....	182	21.00	3.82
25	2″ x 4″ x 8′ 0″	Porch studs and balcony joists, No. 2 Yellow Pine.....	125	18.25	2.28
	4″	No. 2 Yellow Pine Flooring for entire floor	1,230	18.50	22.75
	4″	No. 2 Yellow Pine Flooring for roof	1,560	18.50	28.86
	4″	No. 2 Yellow Pine Flooring for balcony floors.....	210	18.50	3.88
	6″	No. 2 Yellow Pine Drop Siding.....	1,952	20.80	40.60
30 ft.	¾″ x ¾″ ¼-rnd.	Yellow Pine.....	.....	½c ft.	.15
140 lin. ft.	1″ x 8″	No. 2 Yellow Pine for frieze.....	.....	19.70	2.75
154 lin. ft.	1″ x 6″	No. 2 Yellow Pine for water table....	.....	14.80	2.27
172 lin. ft.	1″ x 5″	No. 2 Yellow Pine for casing..	.....	13.30	2.28
96 lin. ft.	1″ x 10″	No. 2 Yellow Pine for porch seat.....	.....	26.50	2.54
		Total Cost of Lumber.....			$157.08

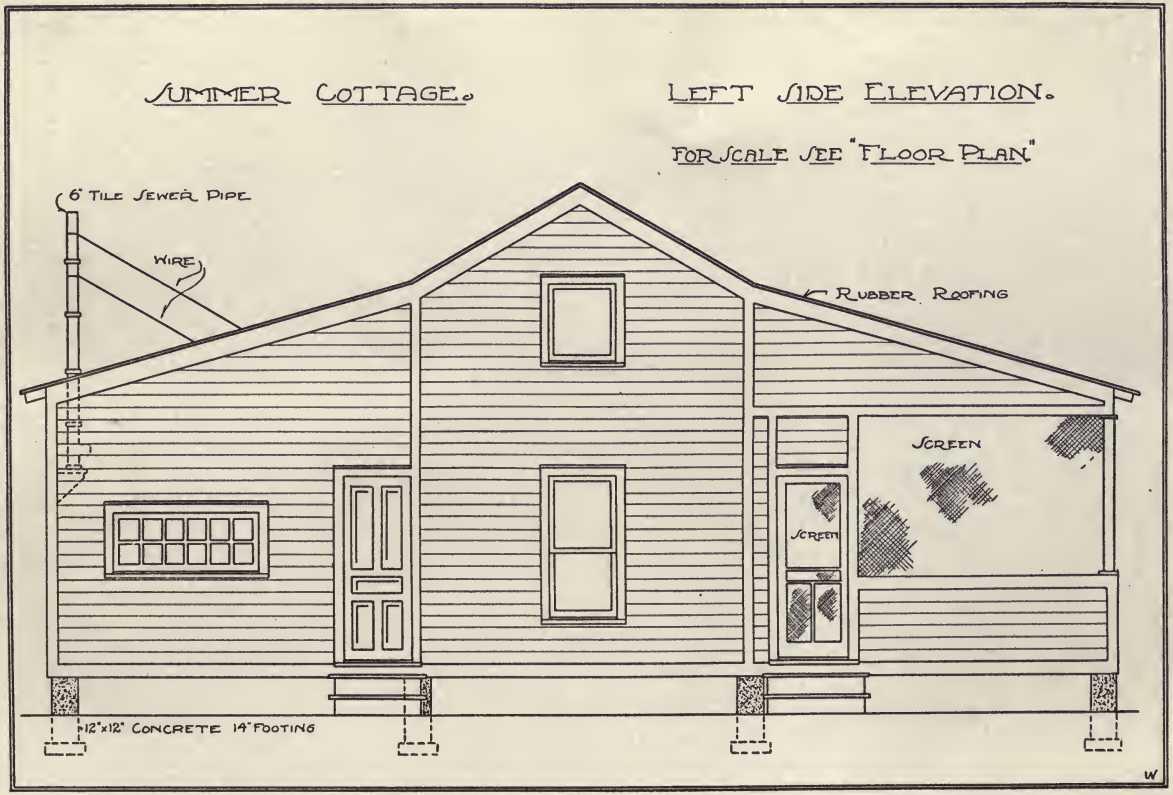
MILLWORK

4 only B grade door frames for 3′0″ x 7′0″ doors @ $1.80	$7.20
3 only 5-panel painted doors 1⅜″ x 3′0″ x 7′0″ @ $1.60	4.80
1 only Black Wire Screen door 3′0″ x 7′0″ @ $1.85.....	1.85
4 only B grade window frames opening 2′8″ x 5′6″ @ $1.25	5.00
4 only 2-light check rail windows 28″ x 30″ @ $1.32	5.28
3 only B grade window frames for single sash 5′8″ x 2′4″ @ $1.25.....	3.75
3 only 12-lt. single sash glass 8″ x 10″ sash 5′8″ x 2′4″ @ $2.85	8.55
2 only B grade frames for attic sash opening 2′4″ x 2′5″ @ $1.10	2.20
2 only Attic sash glass 24″ x 24″ @ 0.86.....	1.72
Total Cost of Millwork.....	$40.35

HARDWARE AND MISCELLANEOUS ITEMS

312 ft. screen wire cloth, black @ 2c square foot.....	$6.24
1560 sq. ft. rubber roofing @ $1.25 roll of 108 sq.ft. (15 rls.)	18.75
4 lengths 6″ vitrified sewer tile @ 20c each.....	.80
1 only T-branch of 6″ vitrified tile @ 40c each.....	.40
7 sacks Portland Cement @ 40c sack.....	2.80
1 kitchen steel sink 18″ x 36″ @ 1.50.....	1.50
1 pr. cast iron sink brackets 18″ @ 35c pair.....	.35
1 cypress sink drip board @ 55c.....	.55
1 Pitcher spout pump 3″ bore, 1¼″ pipe @ $1.08.....	1.08
1 1¼ pipe drive point @ 86c.....	.86

(*Continued over leaf.*)


SUMMER COTTAGE.
LEFT SIDE ELEVATION.
FOR SCALE SEE "FLOOR PLAN"
6" TILE SEWER PIPE
WIRE
RUBBER ROOFING
SCREEN
SCREEN
12"x12" CONCRETE 14" FOOTING
W

HARDWARE AND MISCELLANEOUS ITEMS—Continued

20 feet 1¼" pipe @ 6c per foot for pump	1.20
10 feet lead pipe for sink drain @ 13c foot	1.30
20 feet 1¼" pipe to carry sink drain away from cottage @ 6c	1.20
1 only 1¼" coupling to attach drive point to pump pipe @ 6c	.06
1 only drive cap for 1¼" pipe @ 12c each	.12
2 pieces 1½" iron pipe 9' long @ 10c foot for balcony supports	1.80
2 pcs. 1½" pipe 10' long @ 10c foot for balcony hand-rails	2.00
2 pcs. 1½" pipe 3' long @ 10c foot for balcony hand-rails	.60
8 only floor plates for 1½" pipe @ 5c each	.40
2 90 degree elbows for 1½" pipe @ 12c each	.24
5 pair butt hinges for single sash windows @ 10c pair	.50
5 transom catches for single sash windows @ 15c each	.75
16 window spring bolts @ 1c each	.16
3 pair loose pin butt hinges, 3½" x 3½" @ 14c pair	.42
3 lock sets @ 43c each	1.29
1 complete screen door set, hinges, pull, spring, and hook @ 15c	.15
150 lbs. 8d common wire nails (1½ kegs) @ $2.03 keg	3.05
20 lbs. 16d. common wire nails @ 4c lb	.80
5 lbs. 4d wire finish nails @ 5c lb	.25
2 gals. mixed paint for primer @ $1.25 gal	2.50
1 gal. boiled linseed oil @ 75c gal	.75
2½ gals. mixed body color @ $1.25 gal	3.13
1 gal. mixed paint for trimming @ $1.25 gal	1.25
1 qt. sash paint @ 35c	.35
1 pt. white shellac @ 36c	.36
1 gal. porch floor paint @ $1.80 gal	1.80
Total Cost of Hardware	$59.76

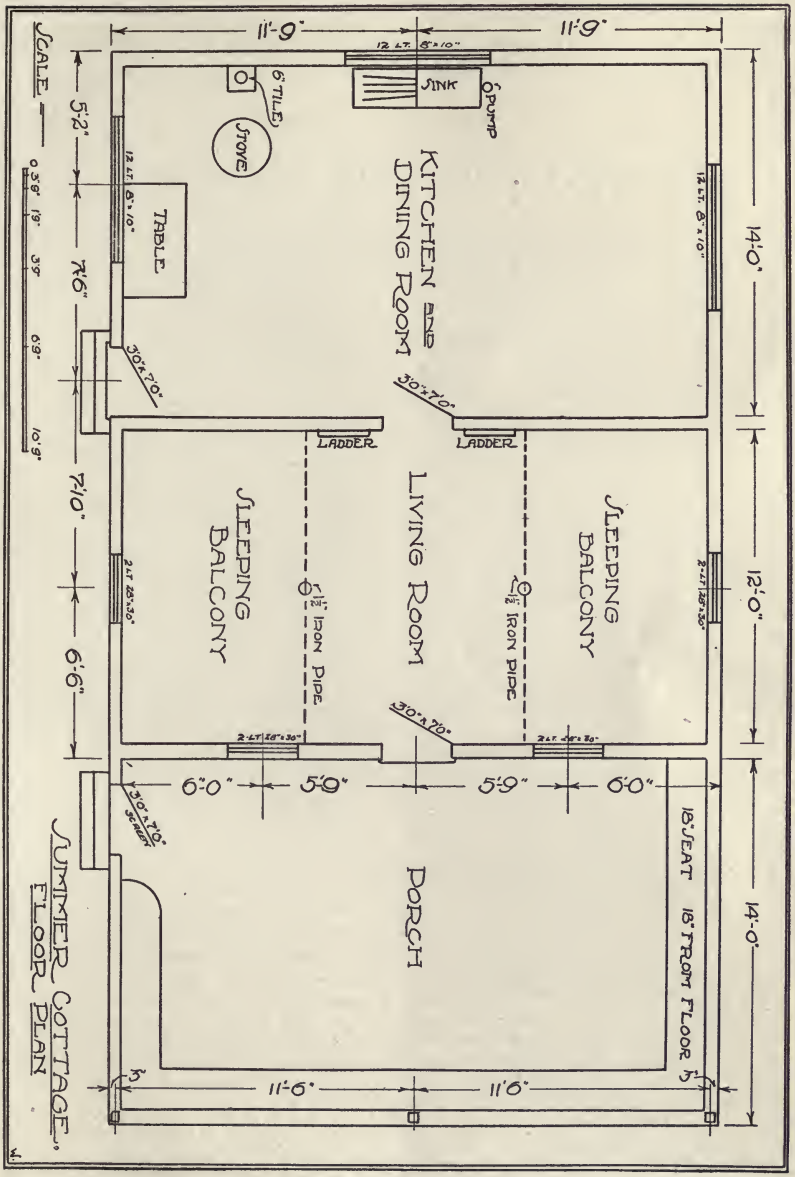
RECAPITULATION

Cost of Lumber	$157.08
Cost of Millwork	40.35
Cost of Hardware and Miscellaneous Items	59.76
Total Cost of Cottage	$257.19

This total cost is based on new materials throughout, and is figured very completely. It can be shaved below the $200 mark by cutting out some of the apparent luxuries. For instance, a cheap grade of sheathing may be used on the roof instead of the matched flooring, but this is not a good practice where rubber roofing is used; the single sash twelve-light windows and frames will need to be made to order, as they are not stock sizes. The builder may change their size to some stock size if he cares to, which will cut down their cost a little. The screening may be omitted and put on later, and only one coat of paint over the primer may be used the first year, but both of these things add so much to the comfort and beauty of the cottage that they are strongly recommended.

No color is given for the paint, but a gray is advised for the priming coat, and two shades of green for the body and trim. Of course, the sash paint will be black.

Before ordering any material, we would advise the craftsman to study over the bills and the plans, and become very familiar with every item and its use. A great help to those who are unfamiliar with the terms and names employed will be found in the catalogues that may be had upon request from the large mill-


11'-9"
11'-9"
14'-0"
12'-0"
14'-0"
12 LT. 8'x10"
SINK
PUMP
6" TILE
STOVE
KITCHEN AND DINING ROOM
TABLE
3'0"x7'0"
3'0"x7'0"
LADDER
LADDER
SLEEPING BALCONY
LIVING ROOM
SLEEPING BALCONY
2 LT. 28"x30"
2½" IRON PIPE
2½" IRON PIPE
2 LT. 28"x30"
2 LT. 28"x30"
3'0"x7'0"
6'0"
5'9"
5'9"
6'0"
3'0"x7'0" SCREEN
PORCH
18" SEAT 18" FROM FLOOR
11'-6"
11'-6"
5'-2"
7'6"
7'10"
6'6"
SCALE
0 3'6" 1'9" 3'9" 6'9" 10'9"
SUMMER COTTAGE.
FLOOR PLAN

work supply houses located all over the country.

It is understood, of course, that the craftsman has his own tool kit, but in the next instalment of this series we will itemize the tools needed together with instructions for the beginning of the cottage.

THE TWO-SPEED INDUCTION MOTOR

ONE of the greatest objections to induction motors has always been the lack of economical speed control. Of quite recent date a two-speed motor has been introduced into the electrical field for application to such shop machinery as may require different speeds. The speeds above, below and intermediate to both speeds of the motor, required on such machines as wheel lathes, shapers, etc., are obtained by shifting the gearing of the machine itself.

In appearance and mechanical design this motor resembles any other squirrel cage induction motor, the rotor being identical. A very marked difference, however, is found in the end connections of the winding of the stator element, that is, by merely throwing a switch the number of poles in the stator winding is doubled, thereby decreasing the speed by one-half.

It will be recalled that the synchronous speed of any alternating current motor, in revolutions per second, is equal to the frequency or the cycles per second divided by the number of pairs of poles, so that by doubling the number of poles the speed is decreased one-half.

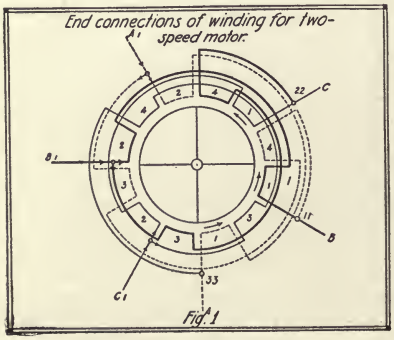


Fig. 1

For motors having two speeds, for example, 900 and 1800 revolutions per minute, the number of poles in the stator corresponding to these two speeds is eight and four, respectively, with the frequency of the supply being sixty cycles per second.

Fig. 1 shows the end connections that are used with the 900 and 1800 R. P. M., 60 cycle, three-phase motor. The quartered circle within the center part of the diagram represents the four poles set up in the stator winding. The three phases are represented by heavy, dotted and light lines, each quarter or pole being composed of three phases, each phase in numbers 1-2-3-4, etc.

No special auto-starter is required in the connection of the motor, but a special four pole, double throw switch, shown in part C, Fig. 2, having thirteen points, is needed and placed between the motor and the auto-starter.

It will be noted that when the switch is closed in the upper position one blade short-circuits the three leads connected to the bottom of it, these three jumpers being put on at the time of installation.

When the machine is set for low-speed operation the switch is thrown to the down position and the leads from the motor marked *A, B* and *C,* Fig. 1, are connected to the respective leads from the switch marked in a similar manner and to the line through the auto-starter, while the leads from the motor marked *A*1, *B*1 *and C*1 are open.

From Fig. 1 it is seen that at a given instant the direction of flow of the current in each phase winding of each pole is the same. For example, by tracing the *A* phase through, beginning at *A,* each

group of coils marked 1-2-3-4 are placed to form positive or north poles, the negative or south poles being of a consequent formation. Accordingly, when the switch is thrown for low speed, or the higher-number-of-poles position, four positive or north poles and four negative poles, known as consequent poles, are produced.

The end of the *A* phase winding ends at the beginning of *B* phase and is marked 11; the end of the *B* phase winding ends at the beginning of the *C* phase winding and is marked 22; the end of the *C* phase winding ends at the beginning of the *A* phase and is marked 33, thus forming a delta connection as shown in part *a*, Fig. 2.

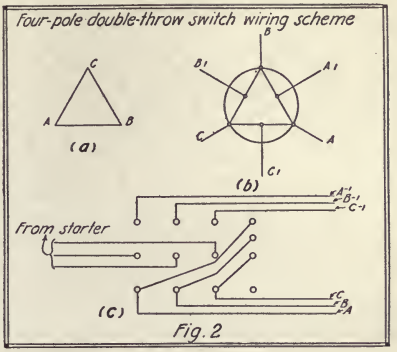
Referring to Fig. 1, when the four pole switch is thrown to the up or the high speed position, the leads *A*1, *B*1 and *C*1, from the motor, are connected through similarly marked leads of the switch, thence through the auto-starter to the line and the motor leads *A, B* and *C* are short-circuited.

Again referring to the diagram and tracing the path of current through any phase, for example, the *a* phase, we begin at *A*1 and find that the current goes both ways, thus forming two negative poles, 2-1, and two poles, 3-4.

The other phases, *B* and *C*, may be traced in the same manner, thus when the switch is thrown to the position for the higher speed or the lower number of poles, the windings are connected so that alternate north and south poles are produced.

With this connection, the switch being up, the leads *A, B* and *C* are short-circuited as shown in part *b* of Fig. 2; the circle representing the short-circuit. The circuits are split and fed both ways from the points *A*1, *B*1 and *C*1, thus forming a parallel star connected winding.

Upon first thought it would seem to be the same to connect *A, B* and *C* in the place of *A*1, *B*1 and *C*1 at the switch. However, this is an error as has been shown. Although the motor will operate with either connection, the magnetic flux will not be evenly distributed when the motor is running at the high speed with the reversed connection, which will be



verified by following out the connections in the reversed manner mentioned.—J. H. WICKMAN.

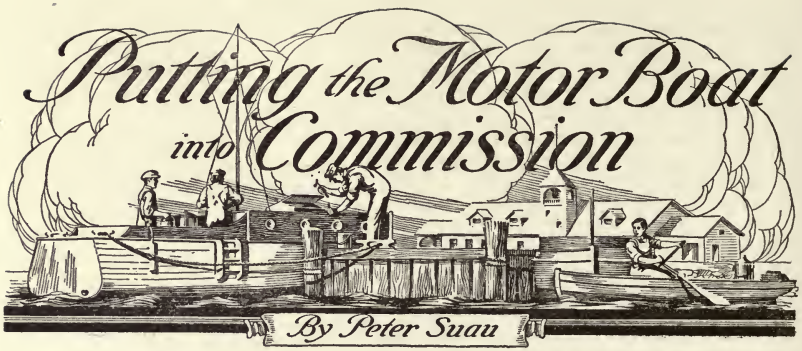
NEW RADIO STATIONS AT CANAL ENTRANCES

According to a recent issue of the *Canal Record*, the following facts are gathered concerning the powerful wireless stations that are being erected in the Canal Zone by the Government.

An antenna has been strung between the new steel masts of the Colon radio station and a series of receiving tests has been in progress. All of the equipment of the plant is ready for use and the towers are completed with the exception of the final riveting. It is expected to have the new plant in full operation upon the receipt of the new spreaders, specially designed of monel metal.

For the Balboa station, the erection of the first of the two steel towers was begun on February 17. These towers will be like those at Colon, self-supporting, 300 feet high, and set 600 feet apart. The apparatus for the Balboa station has been installed complete and is ready for use upon the completion of the towers and antenna.

Upon the completion of the new plants, the old equipment in use at the respective stations will be dismantled. Parts of it have been found available for use in the new plants.



THE work of putting the motor boat in commission is a pleasant task for the motor boat enthusiast. There are two ways of accomplishing the task—the right and the wrong. The right way may be a little more difficult, and, at times, slightly more expensive, but in the end it proves to be the most economical. The work of putting the motor boat into commission can be divided into three distinct tasks:

First—Overhauling the engine.
Second—Refinishing the outside of the boat and doing the necessary inside painting for the average boat of, say, 22 to 28 feet, whether cabin or open boat.
Third—Finishing the bright woodwork—the varnished wood.

For the work under the second and third headings, the tools required would be about as follows:

A putty knife of good quality; one or two scrapers; a small and a large paint brush and a varnish brush.

These brushes should be of good quality. While the paint brushes do not have to be of the very best quality, at least the varnish brush should be of a kind the bristles of which will not fall out. These are practically the only implements required, and the materials will follow later.

Overhauling the Engine

As different gasoline motors vary to a great extent, it is quite impossible to give a standard rule for the overhauling. If the motor boat enthusiast be inexperienced in engine work and there is any serious trouble with his engine, it would be well to secure the services of a good mechanic, who should be watched while working. Thus the beginner will gain some idea as to how work of this character should be accomplished.

We will, however, take it for granted that the boat has been put away in the fall with the engine in reasonably good running order. Before launching in the spring, no matter how well the engine ran last year, all bolts and cotter pins should be gone over to see that they are all tight, firmly holding the engine parts in proper position.

There are two distinct types of motors to contend with—one the two-cycle motor, the other the four-cycle. As a general thing, small, single-cylinder motors are of the two-cycle type. The larger motors of two or more cylinders are about evenly divided, and as they increase in size the proportion of the four-cycle type increases.

All that is required for the general overhauling of the two-cycle motor is to see that all bolts are tight and the different parts are in their proper positions. A cup or two of kerosene run through each cylinder before launching will tend to loosen up the cylinder rings, and make the starting of the engine easier.

The four-cycle type of engine, no mat-

ter how well its operation was during the previous season, will require to have its valves ground. For the uninitiated it may be added that the valve is at one side of the engine where the mixture of gasoline vapor and air enters the cylinder, and is known as the "intake valve." On the other side of the engine another somewhat similar valve is found, which is designated as the "exhaust valve." There is a set of valves for each cylinder of an engine.

If the motor boat owner cannot, with reasonable certainty, remove these valves, it would be advisable to secure someone's assistance who is acquainted with the type of motor in question. To remove the valves of most motors it requires a tool known to the trade as a "valve lifter." This tool compresses the valve spring and permits the removing of the proper pin, thus releasing the valve from its seat.

The valves have beveled faces which rest against a beveled seat, making perfect contact, or at least reasonably so, in order that the compression of the engine is not lost when the valve is closed. The valves should be taken out and thoroughly cleaned, and a good grinding compound secured. Such compounds can be obtained at any garage or automobile supply store in two grades—medium, rough and smooth.

Upon examination of the valves it will be noted that the intake ones are practically clean, whereas the exhaust valves are pitted. To grind the exhaust valves, take a small quantity of the rough grade of grinding compound and smear it over the beveled surface of the valve; then take a screw-driver and insert it in the slit in the valve head and turn it backwards and forwards, lifting the valve at short intervals and changing its position. This grinds the surfaces evenly and does not give any extending portion of the beveled surface of the valve head a chance to grind its way into the seat. After this has been done for some little while it will be noticed that the pitted surfaces are gradually being ground out. When they are fully ground away, the beveled surface of the valve and the beveled seat upon which the head sets should show a reasonably smooth surface. It is then time to use the finer grade of grinding compound to smooth them off.

It is well to state at this point that since the grinding compounds usually contain more or less emery, the valve and the valve seat must be cleaned thoroughly before the engine is in any way operated, since if any emery should enter the cylinders in any quantity it would ruin the engine beyond repair. To ascertain if the grinding of the valve is perfect, give the valve seat a thin coat of colored paint and drop the valve head into place, but do not turn it in any way. Remove the valve and examine it carefully. If the beveled surface on the valve head is equally covered on all sides with the paint, the contact between it and its seat is perfect. Any portions that are not coated with paint indicate that there are spaces between the valve and its seat, and obviously will allow leakage when the engine is running. Under these conditions, clean all the color off and proceed as at first until the valve sets correctly.

If the engine is in a boat of the cabin type, the wiring to the spark plugs is probably in good condition. However, should the engine be in an open boat it is advisable to rewire the engine. If the grade of wire required is not known, it is wise to take a sample of the different

Finishing the Bright Woodwork of a Motor Boat Is a Comparatively Simple and Inexpensive Task.

sizes when purchasing the new wire. If the engine be of a complicated type, that is, of two or more cylinders, all wiring should be followed from the spark plug to its source and tagged or designated by some mark, so that when removed it can be replaced correctly.

Refinishing the Outside of the Boat and Painting the Inside

The materials required for the refinishing of the outside of the boat and the inside painting for salt water use are as follows:

Putty, white lead, white French zinc, linseed oil, turpentine, drier and selected coloring matter for the paint, red lead, copper paint, oxalic acid, varnish remover and varnish.

Sandpaper in a coarse, or No. 2, grade, and a finer grade, such as No. 0. For the rough work, steel wool of a grade equal to the No. 2 sandpaper may be used, perhaps with better results.

The outer portion of the boat, aside from the bright woodwork, should be sand-papered thoroughly with the No. 2 grade of sand paper, or rubbed with the steel wool, until the surface is smooth. Then, with a putty knife, examine all the seams in the boat to see that the last year's putty is not loose. Any loosened putty should be removed. Where the putty is cracked but is held securely in place, do not take it out, since the planking of the boat when once in the water will swell up and close these cracks.

Spots will be found where the seams have contracted and pushed the putty out. At these places cut with the putty knife until level with the planking. The next operation should be to take a small quantity of white lead paint mixed as follows:

Take a clean can and, with the putty knife, remove, say, a pound of white lead from the white lead pot and put it in the can. Pour in enough turpentine to make a thick, heavy paste. Then add linseed oil, mixing the paste with a clean stick until the paint runs off the end of the stick in a rather heavy stream. If too thick the paint will run very sluggishly; if too thin it will drop like water. A happy medium must be struck.

For a pint of white lead paint about an ounce or two of dryer will be sufficient for the purpose to which this paint is going to be put. It is advisable to mix paint at least three or four days in advance of the time when it is going to be used, as this gives the ingredients an opportunity of becoming thoroughly mixed.

The paint being ready, the small paint brush now comes into use. Wherever the putty has been removed, paint the seam thoroughly; by this is meant on the two surfaces at right angles with the outside of the planking. After this has been done the paint should be allowed to dry for at least two or three days. The seams are then ready to receive the putty. The putty, in itself, is not adaptable to boat use and accordingly a mixture should be made as follows:

Take a clean piece of board and with the putty knive remove from the pail a quantity of putty and place it on the board. Then take a quantity of the pure white lead and mix thoroughly with the putty. The proportions should be about 15 to 20 per cent. of white lead to 80 per cent. of putty.

When thoroughly mixed, the prepared putty should be of a consistency that can be kneaded in the hand without sticking to the fingers. If too much white lead is introduced the mixture will stick to the hands.

When the mixture has been well worked up and the white lead thoroughly mixed in, putty the seams as follows: The putty is forced into the seam with the putty knife; the person doing this work being careful to see that the seam is entirely filled with putty up to the level of the planking. Otherwise when the mixture sets it will sink inwards, making a hollow seam which is very homely in the finished boat. When the puttying is completed, at least three or four days should intervene before the first coat of paint is applied.

It is peculiar, but nevertheless so, that copper paint will not adhere to white lead paint. If the white lead paint goes below the water-line and the copper paint is put on over it, experience has taught that before the boat has been many days in the water the paint will start to come off. It is, therefore, advisable to put a coat of the copper, or bottom paint, on first.

Copper paint is secured ready mixed.

The brown copper paint is the best, as it repels any marine growth. This grade of copper paint costs from $2.25 to $2.75 per gallon. Upon opening the can the paint should be thoroughly mixed with a stick, as the copper in the liquid settles on the bottom very rapidly. Copper paint applied to the bottom of the boat will usually dry hard in about six hours. However, before applying the copper paint, any metal work below the surface, such as the skeg and the rudder which very often are of iron, should be given a coat of red lead paint. The copper adheres readily to the red lead paint, which may be made as follows:

If the Varnish on a Boat is in Poor Condition, It is Better to Remove It Entirely and Then Refinish.

Pour about a pint of linseed oil in a can and then drop in the red lead powder while stirring. Sixteen ounces of linseed oil will take at least a pound or slightly more of red lead before it has the proper body for painting. This also requires a small quantity of drier, of which two ounces will be sufficient.

If the red lead paint when applied and while drying becomes streaky it is because there has not been a sufficient amount of the red lead powder used in making the liquid. This can only be remedied by giving the metal parts in question another coat. The painting above the water line may then proceed.

We will take it for granted that the boat is painted white above the water line. Paint for this purpose can be mixed for obtaining two distinct finishes: One, a high gloss; the other, a dead matte finish. To secure these different mixtures proceed as follows:

FOR THE HIGH GLOSS.

Place in a can about 3 to 4 pounds of white lead and one pound of white French zinc. Pour in turpentine of sufficient quantity to make a heavy paste, and then thin out with linseed oil to the same consistency as explained before. Next add half a tumbler full of the drier. This paint should be stirred continually for at least half to three-quarters of an hour in order to secure the proper homogeneous mixture.

If this paint has been mixed in a paint pail that had white paint in it before, it is advisable to strain the mixture through a piece of cheesecloth into a clean pail so that the paint will be absolutely free from any skins.

Apply the paint with even strokes running lengthwise, and do not remove the brush abruptly from the planking, as this will leave marks which, when the paint is dry, will show. After the first coat has been applied it should be allowed to stand for at least 36 to 48 hours to dry hard. Then proceed to look over the surface of the paint to see if there are any dents, or if the seams have any holes in the putty. If any blemishes of this character are found, fill to the surface with the white lead putty. The white lead putty must be permitted to dry hard before the next operation can take place. After it has dried hard go over the surface lightly with the No. o sandpaper, then apply the second coat of white paint. At this stage of the work the surface of the planking should be perfectly smooth and the seams should not show through. By this is meant that from the water line to the top of the boat the planking should appear as one solid piece. Two coats of good paint should be sufficient. If, however, there are any marks, proceed as before with the putty and sandpaper, and give a third coat.

TO SECURE THE DEAD MATTE FINISH.

Take 60 per cent. white lead, 40 per cent. of white French zinc. Thin out to the consistency required for easy painting, as explained before, with turpentine. *Do not put in any drier.* If the quantity of paint mixed is a gallon at one time add about one-half pint of linseed oil.

Proceed to paint as in the other instance. If any of the white paint has run below the water line, remove it with the putty knife or sandpaper and proceed with the second coat of copper paint. The French zinc used in the white paint is intended to keep the paint white. Ordinarily, white lead paint will turn yellow if it is not mixed with a sufficient quantity of the zinc. It should be mentioned here that the linseed oil for white paint should be of the bleached type. For colored paints this is not necessary, the ordinary raw linseed oil being quite satisfactory.

For cockpit floors, the mixture of the paint is slightly different. The white lead is mixed into a heavy paste with turpentine to which is added equal parts of a fair quality varnish and linseed oil, finally including any desired ground color and oil until the desired shade is secured. If the paint is too thick, add more of the varnish and linseed oil. To this paint add drier. As will be noted from the foregoing, the drier varies according to the quantity of paint being prepared, but it is at all times a very small portion of the mixture—about two ounces to the pint. This mixture comprises a paint that is more durable for floor purposes than those in which the varnish is left out. It might be added that an excellent coloring matter for this purpose is raw sienna. It gives a light, yellowish buff tint, which is very popular and shows dirt less than many other shades of paint. This paint can be used to advantage for the outside top of a cabin cruiser, as well as for all floorings and decks. For inside woodwork in a cabin type of boat where white paint is used, the same mixture as used on the outside planking will be found excellent. It is, however, better to use the gloss finish paint, as the one that produces the matte surface is not so adaptable for inside work.

Finishing the Bright Woodwork

The condition of the bright woodwork has a great deal to do with the procedure of finishing. If the wood has been well taken care of it is practically a simple matter to renew its finish without great difficulty, whereas if the varnish has been allowed to wear off in the preceding season it will probably require total refinishing.

We will take up the first condition, *i. e.,* the woodwork in fairly good condition.

The first step is to scrub the woodwork thoroughly with hot water and soap, then go over it with a bleach. The bleach is made up as follows:

Take, for instance, an ordinary quart bottle and fill it about three-quarters full with plain water. Add oxalic acid until the solution becomes saturated; *i. e.,* when the oxalic acid settles at the bottom of the bottle and the water will not take up any greater quantity than it has already taken.

Spread the bleach thoroughly over the woodwork and allow it to dry. This solution will not in any way attack the old varnish, but it will bleach the wood where it is uncovered. About 24 hours will suffice for the bleaching process. Following this the bleach should be thoroughly washed with a solution of half water and half ordinary vinegar. When thoroughly dry go over the work lightly with a very fine grade of sandpaper. If the sandpaper is coarse it will scratch the varnish that is already on the woodwork, which will show through when the new varnish is applied.

The foregoing accomplished, the varnishing can now proceed. This should be well worked out with the brush. Varnishing should be done only during dry, clear weather.

If the finish of the workwork is in a very poor condition, the old varnish will have to be entirely removed. To remove it proceed as follows:

Cover a small patch of the woodwork with a varnish remover, which practically takes effect immediately, and follow with the scraper. When the woodwork has been entirely gone over and the old varnish removed, it should be stained, provided a stain was used before.

These stains are obtained ready mixed. If, however, the wood is in the natural state, such as oak or mahogany, it is preferable to finish it without stain. When the old varnish has been removed from the natural wood and no stains are used, the bleaching process with the oxalic acid is resorted to as in the other instance. When the woodwork is thoroughly washed and dried it should be gone over with a rag or piece of cotton that is saturated with linseed oil. Before the linseed oil has dried thoroughly, sandpaper with No. 0 sandpaper. This acts as a filler, making a better surface for the varnish, and is, in every way, better than a ready prepared filler, as it takes greater labor to refinish the woodwork again, even when the regular filler has been used. Permit the oil to dry for at least 24 hours, and then wipe off clean with a cloth and proceed to varnish. For all outside decks and woodwork which are exposed to the elements, at least three coats of varnish should be given, and then one coat once a month during the season.

Possessing a Fair Ability in Handling Tools and a Liberal Amount of Spare Time, There Is No Reason Why the Average Boat Owner Should Not Do His Own Repairing.

In purchasing spar varnish be sure that it is the very best procurable. This spar varnish will cost in the neighborhood of $4.50 per gallon.

Do not add anything to the varnish in the way of turpentine or other paint mixtures, as they will spoil the varnish. In handling the can do not shake it, as this causes air bubbles in the varnish which will spoil the finish when applied to the wood. If, by accident, a can of varnish should be shaken, it must be allowed to stand until all the air bubbles have disappeared.

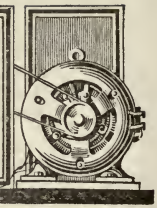
NEW NITROGEN-TUNGSTEN STREET LIGHTS A SUCCESS IN SEATTLE

There are probably fifty cities in America which lay individual claim to being "The Best Lighted City in America." Seattle, Wash., however, really has well-founded claims to the distinction. Seattle is the first city to exploit the new nitrogen filled, low voltage tungsten lamp for street lighting, and by an ingenious and effective method of diffusion the streets are flooded to all points with the genial glow. These lamps have the highest efficiency of any practical street lamp yet devised, and, due to their satisfactory behavior, the Government has selected them as a means for illuminating all of the locks at the Panama Canal.

If you enjoy THE WORLD'S ADVANCE, tell others; if not, tell us.

HOW ELECTRIC MOTORS are STARTED

By M·H·Erdmann



STARTERS of various kinds were described in the first part of this article, which appeared in the April issue of THE WORLD'S ADVANCE. The second part of the discussion follows:

True and absolute current limit acceleration can only be secured by the use of the series wound accelerating switch; *i. e.*, a switch whose operating coil is so wound as to adapt itself for connection in series with the motor to be accelerated. There are two types of such switches on the market at present, both of which operate upon similar principles. The general schematic arrangement of one of these types of switches is shown in Fig. 6. The winding *I* is carried by a brass tube within which the core *E* is free to reciprocate vertically. The upper end of this core carries a non-magnetic stud to which is attached a copper contact plate *G*, adapted to make contact with a pair of contact brushes *H* when the switch is closed. The lower end of the core is reduced in cross section and forms a stem *F*, which meets the body of the core to form a shoulder. The stem *F* passes into a hollow adjustable plug *C* which is of magnetic material. The winding of the switch is enclosed and protected by a semi-cylindrical iron casing *A*, which also constitutes the return member of the magnetic circuit. The upper member of the frame or case *A* is provided with a plug or polepiece *B* of magnetic material. When the current flows through the winding *I*, magnetic flux passes between the plug *B* and the upper face of the core *E*. Substantially all of this flux is normal to the face of the core *E* and is effective in producing a magnetic pull tending to close the switch. At the lower end of the core, however, the flux has two paths. One of these is from the horizontal portion of the frame *A*, into the sleeve or hollow plug *C*, and from the upper face of this sleeve through an air gap into the shoulder on the core. This portion of the flux takes a direction practically normal to the face on the shoulder of the core and produces a magnetic pull which tends to move the core downwards, or, in other words, tends to prevent actuation of the switch. Through the second path at the lower end of the core a portion of the flux passes directly into the stem or extension *F* in a direction at right angles to the direction of motion, and this portion of the flux is therefore not effective in producing a pull on the core in a vertical direction. The total flux divides between these two paths inversely as their reluctance. With a small current in the winding *I* substantially all of the flux passes directly into the extension *F*, this path being of much less reluctance than the path including the air gap. The extension *F*, however, is of restricted cross section and as the magnetic force is increased the reluctance of this path increases and more and more of the flux is crowded into the air gap.

The core *E* is then acted upon by two forces: one, the magnetic pull at its upper end which tends to close the switch; and the other made up of the weight of the moving parts plus the downward magnetic pull at the shoulder on the plunger. When the current is below a certain critical value the upward pull is greater than the downward pull plus the weight of the moving parts and the switch will close. When the current is above this critical value the downward pull plus the weight of the moving parts, predominates and the switch cannot close.

The critical point below which the switch will close and above which it will "lock out" is adjusted by screwing the adjustable plug *C* in or out, which adjusts the lower air gap. This has the effect of altering the reluctance in the path, including the air gap with respect to the reluctance of the path through the stem or extension *F*. Screwing in the plug and thereby shortening the air gap has the effect of decreasing the value of the current at which the switch will lock out, while increasing the air gap has the effect of increasing the value of the current at which the switch will lock out.

A simple form of automatic starter employing series wound switches to obtain current limit acceleration and used in connection with a compound wound motor, is shown in Fig. 7. The starting resistance *R* is proportioned so as to allow only 150 per cent. of full load current to flow through the motor when it is in circuit immediately after the

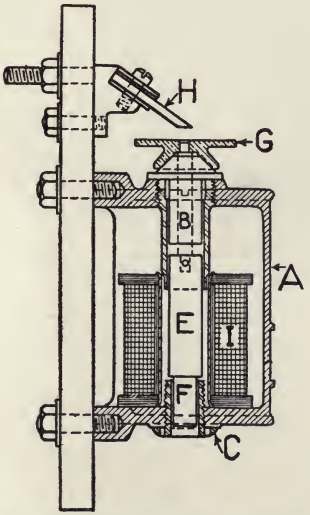


Fig. 6.—Plunger Mechanism of an Automatic Motor Starter.

knife switch *K* is closed to start the motor. This current will lock out the accelerating switch S_1. As the motor gains in speed, the current drawn from the line will decrease until the value is reached at which S_3 will close, short cir-

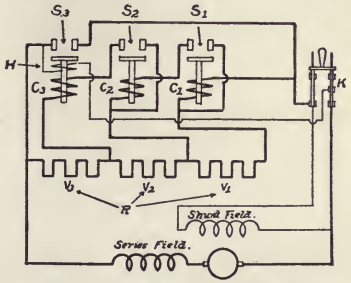


Fig. 7.—A Simple Form of Automatic Starter Employing Series Wound Switches.

cuiting the first section of resistance V_1 and at the same time energizing the operating coil of S_2. This will cause a sufficient rise in current to lock out S_2. Then as the current decreases again it will reach the value at which S_2 will close, cutting out a second section of resistance and energizing the operating coil of S_3. When S_3 closes the motor is connected directly across the line and is receiving full voltage at its terminals.

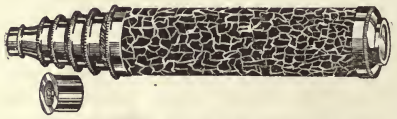
In addition to the regular operating coil, S_3 is also equipped with a shunt wound holding coil *H*, which is supplied with voltage equal to the counter electromotive force of the armature, and which is designed to hold the plunger of S_3 up when it is once in the closed position. The magnetic flux produced by this coil is sufficient to hold S_3 closed, but not enough to close it until the current in its operating coil has dropped to the value for which the switch is adjusted. When the knife switch *K* is opened to stop the motor it opens the circuit to the shunt holding coil, which, in turn, allows S_3 to open immediately, making it possible to close *K* again to accelerate the motor before the armature has come to rest. If this provision were not made the starter would be very undesirable in case it should ever be required to accelerate the motor prior to the armature coming to a dead stop, for with S_3 in the closed position and the motor running at a low

rate of speed, if *K* were closed it would connect full line voltage across the motor's terminals and the result would be either a blown fuse or a collection of fireworks around the commutator.

In conclusion, it might be well to add that all the different general types of automatic motor starters described in this paper can be equipped with shunt contactor switches for starting and stopping from remote points by means of push buttons, float switches or other auxiliary devices. When the shunt contactor is used, provision can also be made for overload protection while the motor is running.

TELESCOPE WITH IMPROVED FEATURES

When we consider that it was early in the seventeenth century that Galileo constructed his first telescope, it would seem that every possible improvement should have been made before the dawn of the twentieth century. Yet as late as February 24, 1914, a United States patent was granted to Franklin B. Warner and assigned to Kirtland Bros. & Company,



Improved Telescope and Special Solar Eye Piece.

of New York, for a new and improved multi-focal telescope.

The improved telescope is arranged to permit of the convenient use of interchangeable objective lenses of more or less magnifying power with different focal lengths, and to allow changing the length of the tubes to correspond to the focal length of each respective objective lens. The instrument is so constructed that the tubes are firm and rigid, and held in alignment at all times.

The multi-focal telescope invention is protected by four very broad claims. Probably the greatest feature of the invention is that the user is enabled to take better advantage of distances and the conditions of light and atmosphere. The telescope is sold with two objective lenses, one for medium range with murky atmosphere, and the other for long range in a clear, rarified atmosphere. Despite its many advantages, the telescope is sold at a very moderate price.

Mr. Warner was granted a patent combination dust cap and solar eye-piece on April 24, 1906. The object of this invention, as its name implies, is to protect the eye-piece end of the telescope from dust and dirt when not in use, and to provide a mount with a dark lens for sun observations. The dust cap solar eye-piece is supplied with the multi-focal telescopes.

With the telescope, eclipses of the sun and moon can be observed with interest. and even sun spots may be seen under favorable conditions. On a farm or ranch of even small size this telescope would pay its cost many times over. In these days of the airship and the aeroplane a new use for the telescope has developed, hence, the person on land needs a telescope to see the ships in air sail by no less than he who dwells by the sea.

ELECTRIC RAILROADS IN THE UNITED STATES

In 1912 there were 1,260 electric street railway systems in the United States employing a total of 282,461 men and representing an investment of $4,708,568,-141. So complete is the network of electric railways in this country that today one can travel from Boston to Chicago with only a few miles of steam travel where there are gaps yet to be filled.

Anyone knowing who the amateurs "IE" or "PWR" are and where they are located, will confer a great favor by reporting the information to John M. Clayton, 1301 Welch St., Little Rock, Ark.

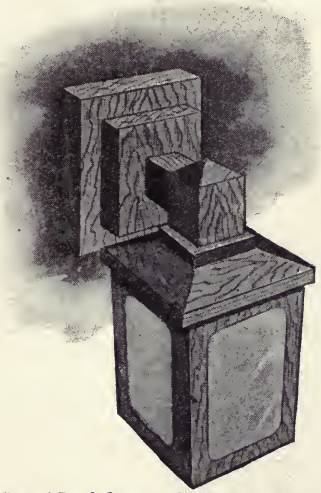
For the Handy Man

Edited by Thomas Stanley Curtis

A Lantern for the Porch

THE project offered in this article will serve either as a lantern for the porch or as a wall bracket of unpretentious but withal pleasing design. If it is put to the latter use the severe side panels may be displaced by others bearing some quaint device sketched upon the wood and cut out by means of the scroll saw. The panel for the porch light is purposely made severe in order that a house number may be painted upon the class. A more artistic piece of work may be made of the lantern if the number is cut directly from the thin wood of the panel and made to form a part of the design itself.

The simple construction of the lantern may be noted with a glance at the drawings in Fig. 1. The lantern proper is composed of four side panels of thin wood fastened together with beveled corners and strengthened by means of the top and bottom frame and corner posts. The dimensions of the lantern as a whole may be determined by using the scale reproduced with the drawings in this figure, cutting it out with a knife.



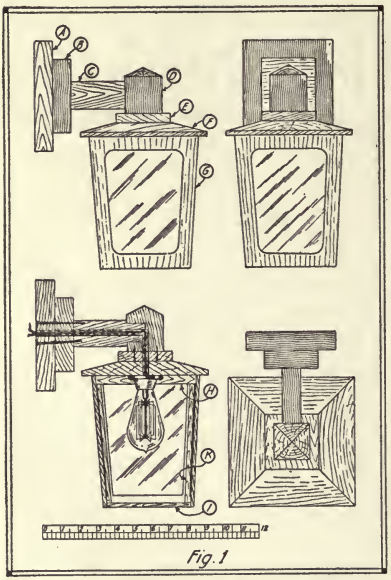
View of Porch Lamp as It Appears When Completed.

For the dimensioned details, the reader is referred to Fig. 2, in which are given the sizes of the various pieces and the number of each required. The bill of materials to be given to the lumber mill is as follows:

(*A*)	1	piece	wood	1″ × 5″ × 5½″
(*B*)	1	"	"	1″ × 3″ × 4″
(*C*)	1	"	"	1″ × 1½″ × 4″
(*D*)	1	"	"	2″ × 2″ × 2½″
(*E*)	1	"	"	½″ × 3″ × 3″
(*F*)	1	"	"	¾″ × 7″ × 7″
(*G*)	4	pieces	"	¼″ × 6″ × 7¼″
(*H*)	4	"	"	½″ × ½″ × 5½″
(*I*)	4	"	"	¼″ × ¼″ × 4½″
(*K*)	4	"	"	¼″ × ¼″ × 6½″

For outside duty, mahogany will be found the most serviceable and for the small quantity of wood required the cost will not be prohibitive. If the lantern is to be used indoors, the wood may be of oak or in fact any wood which harmonizes nicely with the interior decorations.

The first operations, in the event that the lumber has been ordered cut to size and sanded at the mill, will be to make the mortise and tenon joint between the arm *C* and the block *D* after the latter has been pointed at top. The joint should be a good fit and the pieces left separate until after the holes have been drilled and the twin wire passed through. Prior to drilling the holes, the block *B* should be centered upon and

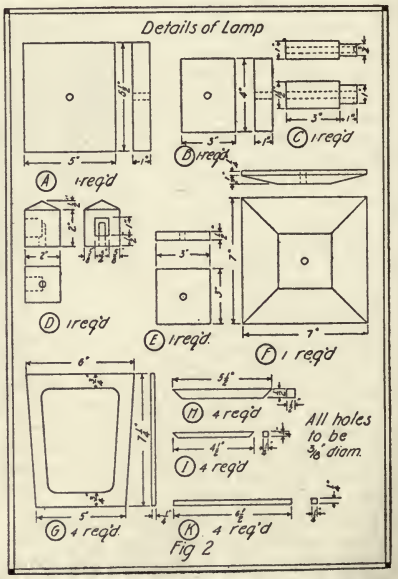


Various Views of Porch Lamp, Showing the Assembly of the Parts.

nailed to the block *A* with a very thin layer of glue between. The arm *C* is then secured to *B* by means of two slender wood screws passing through the two blocks as shown in the sectional view in Fig. 1. The hole may then be drilled through the two blocks and the arm. The bevel may next be cut upon the lantern top *F*. The block *E* is nailed and glued to the post *D* and then the top of the lantern secured to this combination by means of nails and glue. The hole may next be drilled through the lantern top, the block, and the post. The post and arm are still left separate.

The side panels having been prepared and the edges beveled at 45 degrees, the body of the lantern may be assembled. The first operation is to nail the four pieces *H* to the lantern top. The lower frame composed of the pieces *I* is to be assembled independently with glue and nails. The side panels *G* may then be fitted to the top of the lantern and the lower frame, nails being located cautiously at the mitered corners. The fitting of the corner posts *K* to strengthen the body of the lamp brings us to the point where the arm and post *C* and *D* may be fitted together. A piece of incandescent lamp cord of suitable length is bared at its ends and the wire gripped under the lugs of a lamp receptacle. The wire is then passed through the hole in the post and the receptacle drawn up tightly against the inside of the lantern top, where it is secured with screws. The wire is then passed through the hole in the arm *C* before the latter is secured to the post. The application of glue to the mortise and tenon and the bringing of the two snugly together completes the assembly. The reason for holding these two parts separate until the wire has been passed through is, of course, apparent to the reader; it would manifestly be impossible to bring the wire around the corner otherwise.

The glass may be milk white or colored art glass as the builder's preference dictates. The former is in better taste for



Parts of the Porch Lamp with Their Respective Dimensions.

the porch and in such an event an exceedingly pleasing combination is secured if the entire woodwork of the lantern be painted a dead black. If the natural color of the wood is desired, the woodwork should be treated to several coats of good spar varnish both inside and out of the lantern. The greatest problem is to protect the wood from the action of the weather and the best protection is afforded through the liberal application of good waterproof varnish.

INDIGO — AN INDUSTRY THAT WAS KILLED IN A NIGHT

Up to a decade or thereabouts ago one of the most important of tropical industries was the raising and manufacture of indigo for use as a dye. Then, suddenly and without warning, came the news of the discovery of aniline dyes, by which, through inexpensive processes, coloring mediums could be manufactured from coal tar and benzole which answered all the purposes of indigo at a fraction of its cost. This discovery was like a bomb thrown into the midst of the indigo industry, for, as far as their future usefulness was concerned, the plants engaged in the manufacture of that hitherto valuable commodity might just as well have been dynamited. To-day, even in Central America and India where it was most active, it is practically as though the indigo industry never existed.

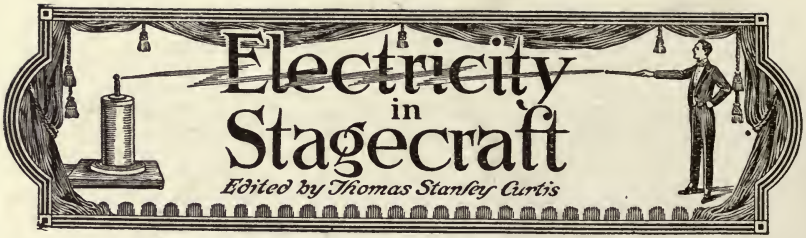
In the light of the passing of the indigo industry, those who are interested in the production, manufacture and sale of rubber are asking themselves and each other if that industry will not be the next one to fall before the inflexible scythe of science. The world production of rubber at the present time, between the wild and the plantation product, is about 90,000 tons, worth anywhere from $150,000,000 to $175,000,000. The investments in the industry must foot up to over a billion dollars. With rubber at one dollar a pound, there is a huge profit in it for the planter, and it is hardly likely ever to go much below that price as long as it comes from the juice of a tree. The area planted to rubber trees would be tremendously increased but for the fear that the discovery of a practicable process of making synthetic rubber at a low price will be discovered. (Such a process has, in fact, been discovered in Germany, but though the ingredients —corn, common salt and lime—are very cheap, the elaboration is still so expensive that the finished product is more costly than natural rubber.) It takes a lot of courage for men to put several millions into a project with the full knowledge that any day may bring news of an invention that will make them paupers at a single stroke. Synthetic rubber at ten or fifteen cents a pound does not sound nearly so remarkable as a score of scientific inventions that have been announced within the year, and few indeed are the optimists among the rubber men who do not feel in the bottoms of their hearts that it is coming.

TELEPHONE PROGRESS IN THE UNITED STATES

The recent completion of the transcontinental telephone line has been the result of a steady progress in long-distance telephonic transmission. The following chronological table is interesting.

Year.	Terminals.	Miles.
1876	Boston-Cambridge	2
1882	Boston-Providence	45
1884	New York-Boston	235
1892	New York-Chicago	900
1911	New York-Denver	2100
1913	New York-Salt Lake City	2600
1915	New York-San Francisco	3400

America, the country that gave birth to the telephone, leads the entire world in the extensive use of this means of communication.



Preparing the Lecture*

NOT the least important feature of the work in hand is the preparation of a suitable explanatory lecture to accompany the experiments which are to be performed with the apparatus described in past articles. Upon the snap and vigor of the lecture depend in a large measure the successful presentation of the offering. It is safe to assume that the day of the electrical fakir is past—no longer can the smooth-tongued performer claim some supernatural power which enables him to take through his body enormous voltages which would prove fatal to the average mortal. The lecturer of this type is as much a thing of the past as is the old-time magician who makes claim to some occult power rather than to sleight-of-hand or mechanical ingenuity to accomplish his tricks. The electrical entertainer of today must bear in mind that in the past five years the education of the general public along the lines of electricity and science has advanced in an astonishing degree, and to offer his experiments under the guise of a wizard is not only to insult the intelligence of his audience, but to stamp himself as an absurd charlatan as well. Just as the modern prestidigitator credits his quickness of hand, so should the electrical entertainer give credit to modern science for his ability to perform the startling experiments he offers.

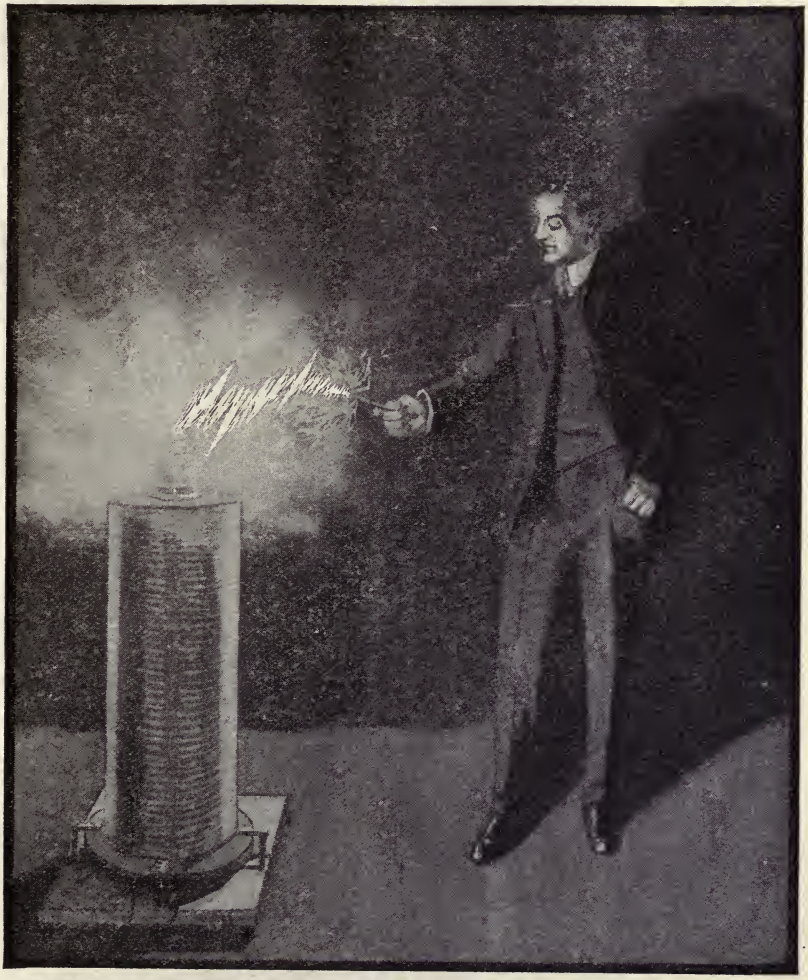
The class of audience catered to should also bear careful consideration. The style of talk favored by the intelligent and well-read Chautauqua assembly would be hopelessly out of place in even a high-class vaudeville theatre. This is not due to the lesser degree of intelligence to be found in the theatre audience so much as to the fact that such an audience demands to be shown rather than told. The experiments must speak for themselves and any lecture accompanying their presentation must be more in the nature of an explanatory "chatter" rather than a discourse on the theory and scientific reasons for the phenomena demonstrated. With the typical lecture audience, on the other hand, the explanatory remarks may be more comprehensive in nature, as such an audience comes to listen and be instructed, as well as to see and be entertained. At the same time the performer must not lose sight of the fact that many of the people in even a scholarly audience are totally unfamiliar with even the fundamentals of electricity except in a vague way, and his discourse should therefore be interspersed with frequent analogies in everyday life in order that the terms and phrases used may be clearly comprehended.

A clever touch of comedy is of almost inestimable value; for the theatre audience it should be of the "slap-stick" variety, while for the lecture assembly it should be genteel or even subtle in nature. As an illustration of the former style of

*This article is one of a series that has appeared regularly in past issues of *Modern Mechanics* and THE WORLD'S ADVANCE since September, 1914. Previous instalments have covered the construction of the apparatus referred to in this issue. Back numbers may be secured at 15 cents per copy while the supply lasts.

comedy, the writer has seen many a mediocre electrical act carried through to a riotous curtain simply because a more cultured audience would have resulted in a few disdainful smiles.

The performer should beware of a



The Theatre Audience Demands to Be Shown Rather Than Told; the Experiments Must Speak for Themselves.

handful of boys from the audience were knocked off their feet supposedly through contact with a wire. The same bit of comedy presented for the approval of a lengthy introduction in either of the two cases. For the theatre, the opening remarks should be exceedingly brief and

(*Continued on page* 695)

Electricity in Horticulture
Edited by Thomas Stanley Curtis

Plant Culture by High Frequency Current

Part III. Construction of the Spark Gap

PERHAPS no one portion of the high frequency current apparatus is more likely to give trouble and to require frequent attention than is the spark gap across which the condenser discharges. The discharge is accompanied by heating effects which are in themselves troublesome, and while the ordinary stationary form of gap may give satisfactory service for a time at least, still its successful operation is hindered, as the sparking surfaces become heated and pitted. The gap to be described has proved its value in actual practice and, while it may appear to be unnecessarily complex in design, still the many points of advantage are only brought out through the construction of a substantial and more or less massive affair.

With reference to the side elevation and plan views in Fig. 1, the gap consists of two 8-inch discs of zinc arranged to rotate in opposite directions at a fairly rapid rate of speed. The rotation serves the double purpose of always presenting a fresh sparking surface, and therefore a cool one, to the point of discharge, and in establishing a strong current of air directly upward and between the sparking surfaces, due to the surface friction of the periphery of the discs. The effect of this current of air is to assist in the wiping out of any arc which may form during the discharge.

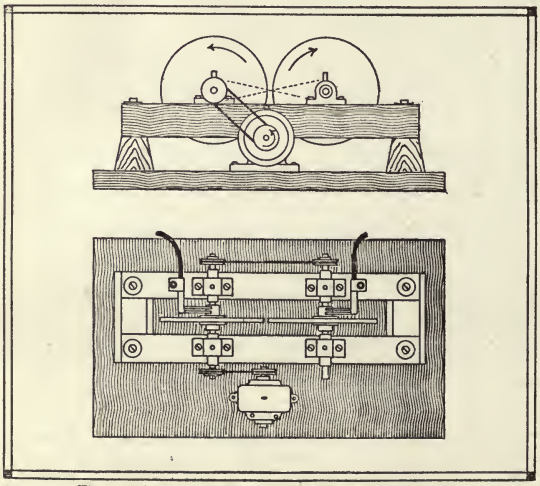


Fig. 1.—Assembled View of the Rotary Spark Gap.

The discs are mounted upon a substantial framework and base of dry wood which has been painted with or preferably boiled in paraffin wax. The discs are mounted upon shafts of ½-inch steel and secured to the latter by means

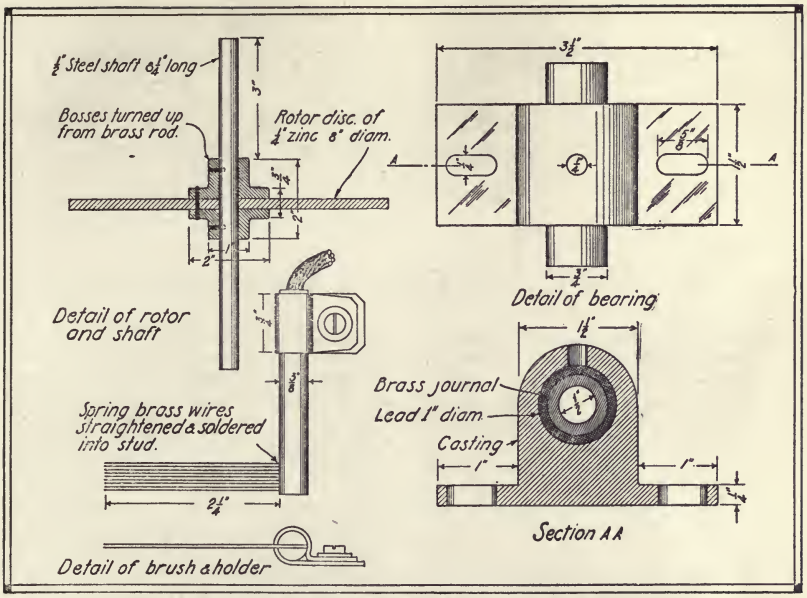


Fig. 2.—Details of Parts of the Rotary Spark Gap, Showing Method of Construction.

of brass bosses turned up and drilled to a snug fit on the shaft. When the final assembling has been done the bosses are pinned to the shaft and to the disc, thus insuring the permanency of the construction. The final operation is to take a finishing cut off the periphery of each disc with the shaft held between centers in the lathe.

The details of the bearings are given in the enlarged drawings, Fig. 2. The reader will note that the bearing proper is a journal of brass tubing reamed to fit the shaft nicely. The bearing support is a casting with a hole cored through it to take the journal. Slots in the feet of the bearings permit the distance between the discs to be varied.

When the various parts have been finished, the bearings are located on the framework as shown in the plan drawing and the journals slipped over the shafts. A piece of cardboard is then forced over each end of each journal after the latter has been propped up inside the bearing with bits of wood. Melted lead is then poured into the opening at the top of the bearing and when cold it will hold the journals in perfect alignment with the shaft. The bearings may then be removed and a small hole drilled down through the lead and brass to afford a passage for oil to the shaft. The addition of an oil cup stuffed with a wick completes the bearings, which may be replaced on the frame.

The shafts are belted together with rubber belting crossed to make the discs turn in opposite directions. The driving is accomplished by means of an electric motor belted to a pulley on one shaft.

The current is conducted to the discs through wire or gauze brushes bearing upon the smooth bosses, as shown in the plan view in Fig. 1. The details of the brush holder are to be seen in Fig. 2.

The discs should rotate freely and quietly when the motor is started. If the oil cups are properly fitted, the gap should be capable of an all-day run without trouble developing. The adjustment of the gap will be considered in due time, when the instructions are given for the operation of the completed apparatus.

Practical Electro Therapy

Edited by Thomas Stanley Curtis

High Frequency Apparatus*

IN the last article we learned that the alternating current, after entering the apparatus within the instrument case, is transformed or stepped up in voltage to a value perhaps hundreds of times as high as that at which it entered the instrument. This voltage would prove dangerous or fatal under certain circumstances if it were applied to the body of a patient in its existing state. Before it can be used, therefore, it must be converted to a current of very high frequency, *i. e.*, one which changes its direction of flow hundreds of thousands or perhaps even a million times per second. The astonishing characteristic of such a current is that it may be applied to the human body in quantities which would prove fatal if the current were of the commercial frequency.

THE CONDENSER AND OSCILLATORY CIRCUIT.

Tracing the course of the high potential current as it leaves the secondary of the transformer, we find that it passes into a device called a condenser. This piece of apparatus consists of a number of sheets of tinfoil separated by plates of mica or glass. The foil sheets are supplied with lugs projecting alternately first from one side and then from the other as the foil and mica plates are assembled. The alternate lugs are soldered together on each side and to these joints the wires from the transformer are fastened. Passing from the condenser we find the current flows through the primary of another transformer, but one without an iron core, and finally across a spark gap and back to the condenser.

The condenser acts as a reservoir for the current, which stores up as a charge on the plates until the tension becomes so great that the current leaps across the spark gap in a crashing discharge. This discharge is not composed of a single spark, as appearances would seem to indicate, but it comprises many separate discharges which surge back and forth across the gap with a motion which may be likened to that of a swinging pendulum. When the energy is finally spent the discharge would naturally cease, but during all this time the condenser is again replenishing its supply from the high voltage terminals of the transformer and as soon as one discharge has died away, there is another charge ready to take its place. All of this happens perhaps in the ten thousandth part of a second or less.

The oscillatory discharge of the condenser across the gap sets up a current of very high frequency in the circuit, which includes the primary of a second transformer in it, as previously explained. Obviously, therefore, it is only necessary to place within this primary a secondary coil having a suitable number of turns of wire in order to obtain a high frequency current of any desired potential. There is no electrical connection between the two in the case of certain forms of apparatus and, owing to the fact that nothing but a current of high frequency would induce another current in the secondary of this transformer—due to the absence of an iron

*This article is the third of a series on high frequency apparatus. The first article appearing in the March issue of MODERN MECHANICS is a general description of a portable high frequency outfit which is described in detail in this and succeeding articles.

core—there is no danger whatever of the patient receiving a shock of low frequency current from the secondary terminals. While this safeguard is not employed in other forms of medical high frequency apparatus, still the method used is quite as effective, and its principle will be taken up in a future article. The aim at present is to cover but one method at a time in order to prevent possible confusion.

The generation of the high frequency current having been explained, the method of adapting it to the various electrodes and their uses will be taken up in the next article.

PREPARING THE LECTURE

(*Continued from page* 691)

"straight from the shoulder," for an audience of this nature is ever impatient for something to happen and the quicker the action throughout the better the reception. If the lecturer is endowed with an unusually commanding presence, which invariably combines the gift of wit or humor, he may carry the action with his own magnetic personality; but for the individual who is not gifted in this manner, the rapid-fire style is safer and less likely to subject him to the disconcerting ridicule of an unruly gallery crowd.

The introductory remarks should be quickly followed up with an impressive experiment; this is to at once arrest the attention and whet the appetite for better things to come. After the successful completion of this one experiment, the performer has, in a large measure, gained the confidence of his people, and in consequence, they will be the more ready to listen to his further remarks. At this point may come the real introduction to the entertainment to follow. The experiments should be placed on the programme in logical order and every effort made to so arrange them that there shall be no wait whatever between the successive demonstrating. This feature will receive attention at length in the next article, however, for space will not permit of justice to it in the present instalment.

The mediocre experiments should be interspersed with the spectacular and startling ones, and invariably the climax should consist of the one experiment that proves to be the masterpiece. It is not always possible to determine just which one from among the number may properly lay claim to this title and this is where the value of "trying it on the dog" comes in. As a matter of fact the final rehearsals of the performance should be before a real audience and a critical one at that, for only in this way can the production be whipped into shape.

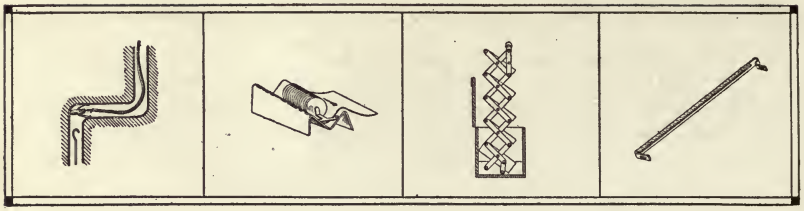
In the next article the author will suggest an effective programme and later articles will carry the reader through the performance of the experiments.

LOCATING BULLETS BY MEANS OF ELECTRICITY

Bullets are now being located by electricity by means of a novel method recently described in the *British Medical Journal.* Briefly, it consists in the use of a telephone, similar to those used in wireless telegraphy. To one end of the telephone wire is attached a small piece of platinum which is placed upon the patient's skin which has previously been moistened with salt water. The other end is in the form of a disinfected thread of silver and is attached to the surgeon's instruments. The instant the instrument strikes the tissue in which the bullet is located, a rattle is heard in the receivers. This method is said to be more practical than the present X-ray one.

WIRELESS CLUB NEWS

The Editors of THE WORLD'S ADVANCE are at all times pleased to hear from wireless organizations throughout the country. Clubs and associations are urged to write in regarding their work. Notices will be published whenever space permits.



Recent Novel Patents

For Wire Fishing

To fish wires through crooked pipes, a Connecticut inventor has brought out a device consisting of a hollow metal body, slotted upon the sides, a plug which fits in it, and wings projecting through the slots and pressing against the walls of the pipe by means of small springs. The wings are intended to prevent the wire from bending back, while their construction, as can be readily seen in the sketch, adapts them for turns.

Coin Wrapper

A patent has been granted to an Ohio inventor on an automatic coin wrapping machine of unique design. It consists of an open, inclined, V-shaped groove and a metal finger for holding the coins in position. Wrapping paper is placed in the groove, under the pile of coins. Great quickness in wrapping coins is claimed to be the outstanding feature of this invention.

Odd Tool Box

An unique tool box containing a number of tool trays mounted on a collapsible lattice framework is the subject of a patent granted to a Pennsylvania inventor. Although the tool box is no larger than the ordinary tool boxes in general use, yet it can be opened and its various trays will form a convenient stand.

A Drawing Board Attachment

A rigid ruling strip of substantial length and provided at its opposite ends with small slotted arms, by which it is attached to a drawing board, is the subject of a patent granted recently to a Chicago inventor. One of the arms is flexible so that the rule can be moved longitudinally without causing the strip to move up and down, thereby causing errors in the drawing.

Pouch for Holding Fruit

The patent office has granted rights to a Washington inventor for a fruit holder consisting of a pouch shaped member to conform to the outline of the palm of the hand, with an open mouth at its forward end. The pouch is fastened to the hand of the user by means of straps about the thumb, little finger and the wrist.

Incandescent Lamp Protector

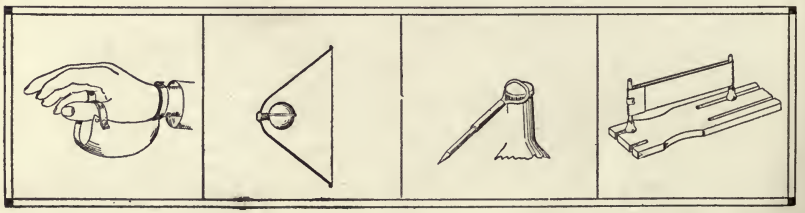
In order to prevent the dangerous glare of automobile headlights, a cup-shaped covering for the incandescent lamp has been invented by a man in Connecticut. According to the patent granted, an elastic arrangement holds the protecting cup in place so that it may be easily attached or detached. Thus any automobile lamp may be prevented from blinding the drivers in passing cars.

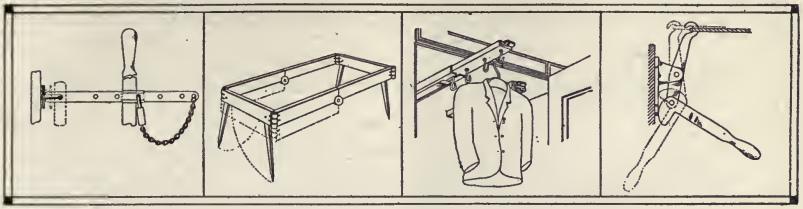
A Bottle Opener

Something out of the ordinary in a bottle-opening tool comprises the grounds upon which a patent has been granted to a Philadelphia inventor. This bottle opener consists of the usual flared wire top, fitted with a hollow, tubular handle. Into this tube a pencil or rod of some sort is inserted and used as the lever. The advantage gained in this bottle opener is compactness, and, if it is fitted on a pencil, it is always handy.

Holder for Photographic Films

An adjustable holder for photographic films is the subject of a patent recently issued to an inventor of New York. It consists of a baseboard made of some stiff material and cut with slots by means of which upright posts, which hold the film, are moved forward and backward to accommodate a film of any length. The film is wound about these posts and held in place by a clip. An unique feature of this film holder is a provision incorporated in the construction of one of the posts, whereby it may be locked automatically in any adjusted position to the baseboard.





A Lock for Automobiles

A locking device designed to prevent the stealing of automobiles is the subject of a patent recently granted to an inventor in Virginia. It is quite simple in structure, consisting of a padlock and chain that serve to lock one of the operating levers of the automobile so that it cannot be moved, thereby preventing the car from being run. A long flat bar, having holes bored through it at intervals, is attached at one end to the body of the car. A slide attached to the lever is moved along the bar until one of the holes in the bar is opposite a hole of the same size in the slide. Through these holes the curved rod of the padlock is passed.

Folding Table

Folding tables of all sorts have been granted patents, but the idea as worked out by a New York inventor has several ingenious features which deserve attention. Altogether, this table folds at ten different places. The four corners are hinged, and pivots at the center of the two long sides permit still another fold. The legs are pivoted also in order that they may be drawn up out of the way.

A Clothes Hanger

A New York inventor, evidently of the impression that there have not been enough clothes hangers invented, has been granted a patent on a new clothes hanging idea. This hanger embodies a sliding rack on which hooks are fastened for suspending clothes hangers of various sorts. The rack slides into a rectangular tube which serves as a runway, so that the clothes on the hooks can be pushed back out of sight into the closet. The runway has a slot cut along the bottom for admitting the passage of the clothes hooks. A semi-circular metal strap is fastened at the top and outer end of the rack, so that it can be pulled out easily and the clothes made accessible.

A Line Stretcher

An instrument for stretching lines and possessing several good features has been patented by a Chicagoan. It comprises a fixed bracket provided with screw holes by means of which it is attached to a post or other support, and a lever having at its upper end a hook for attaching the line, and at the lower end a pivot on which turns a cam controlled by a handle. When the handle is pushed down, a high leverage results and the line is tightened.

A Cigar Press

Cigars must be pressed to conform to the dimensions of a standardized box, and to accomplish this object an Illinois inventor has devised a mechanism for which a patent has recently been issued. It consists of a stationary base, ends and back. Along the edge of the back a linear scale is engraved for measuring the thickness of the compressed pile of cigars. The cigars are placed under a board between one end and a movable block. A rack push bar secured to this block, or partition, pushes against the cigars, pressing them to the desired shape.

A Case for Chewing Gum

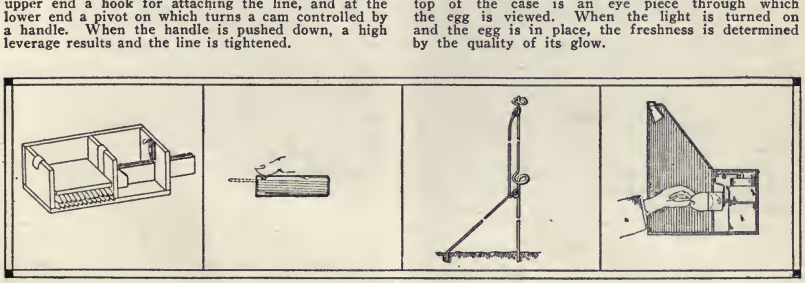
Among the many patents issued recently on mechanical devices comes the refreshing idea from a Kansas inventor of a case that may be used for holding chewing gum, tickets or other similar articles. The chewing gum holder consists of a closed case with a slot at the forward end and a pivoted cog projecting through the top. A spring pressing upward at the bottom of the case forces the sticks of gum against this cog, and when it is turned by the movement of a finger, a stick of gum or ticket—whichever the case may contain—slides out of the slot.

Support for Plants

Among the patents granted recently, a device invented by a man in Texas has well founded claims to novelty and originality. It consists, in brief, of a long wire in which there are several loops or curls. Its purpose is to support growing plants. The rod is intended to be thrust into the earth deep enough so that it will remain erect, notwithstanding the weight which the growing plant places upon it. As a supplementary support another rod, or a number of them, is attached to the upright one at an angle of about 45 degrees and forced into the earth several inches.

An Egg Tester

A novel idea for testing the freshness of eggs has been patented by a man in Missouri. A metal case with a sleeved hole in front, through which the egg is inserted, contains the testing mechanism. The egg is placed in a movable receptacle in the back of which is inserted a miniature electric lamp. At the top of the case is an eye piece through which the egg is viewed. When the light is turned on and the egg is in place, the freshness is determined by the quality of its glow.



Questions and Answers

This department will appear regularly in THE WORLD'S ADVANCE, subject to following regulations: The questions must be legibly written with typewriter or in ink, on one side of the sheet. Each question must be definite and cover but one point of the subject under consideration, although a letter can contain more than one question. On the 10th of the second month preceding the date of issue of the magazine, all the questions on hand will be considered and those which are put in the most intelligent manner and of widest general interest will be selected for publication in such issue, the number being governed by the space available. All other questions will be returned to the writers with a statement of the price for which they will be answered by letter. Return postage must be enclosed with each letter containing questions, and the letters must be addressed to the Questions and Answers Department and contain nothing relative to other departments of the magazine.

LIGHTNING PROTECTION.

In reply to the many requests we receive for information relating to protection from lightning we will offer the following suggestions: All aerials must be protected. It is not merely obeying the regulations, but it is very desirous for the operator's own personal safety. There is very little danger from lightning if the aerial is properly protected, but it is very dangerous to be near one if it is not well grounded during a thunder storm. We have been in the station when the aerial was struck and have observed several other aerials after the bolt had passed. In almost every case there was no damage. The flash of lightning is usually severe and the noise loud, but no damage is done to surrounding property. Frequently insulators are punctured or spreaders splintered, but otherwise the damage is negligible. It would be interesting if amateurs would write to us what happened when their aerial was struck and the extent of damage done, if any, also the type of ground used. Merely burying a copper kettle under the surface will not be sufficient. A pipe driven down at least ten feet should be employed. The better the ground the safer the station will be. The regulations require No. 4 copper wire to connect the aerial to the ground. This should be strongly adhered to. A 100 ampere switch is required, no voltage being specified. If the station has a transmitting set it is best to use a 600-volt switch, so as to prevent the antenna current from jumping across the switch into the ground when the transmitter is being used.

SELENIUM CELL.

(28) C. F. Estwick, Rochester, N. Y., asks:

Q. 1.—Where or how can I obtain a selenium cell which will operate automatically to turn on electric lights in the evening when it begins to get dark and turn them off again in the morning as soon as it becomes light?

Q. 2.—Will this device operate satisfactorily on alternating current at commercial frequencies?

Q. 3.—Will the device work satisfactorily out of doors, in a suitable housing, where it would be subject to variations in temperature due to extreme weather conditions?

A.—It is unfortunate that there should be such a wide misunderstanding of the possibilities of the selenium cell. At its best it is but an experimental device and has not yet been developed so that it is sufficiently reliable and inexpensive to be of commercial importance. In the dark the resistance of selenium is very high, but when a strong beam of light falls on it the resistance is greatly reduced. To use such a cell some form of sensitive relay must be employed, then, of course, the circuit may be closed for direct or alternating current, as the case may be. It has been suggested to use such a cell for turning on lights by having the relay make the circuit when the magnets are de-energized, that is, when the cell is in the dark. In this manner lights could be turned on at night, but as previously mentioned such a scheme is not commercially practicable. A time switch would be about as cheap and infinitely more reliable.

MEANING OF "DYNAMO" AND "MOTOR."

(22) H. N. G., Philadelphia, Pa., asks:

Q. 1.—What is the difference between a motor and a dynamo?

A. 1.—We presume you might have used the word "generator" instead of "dynamo." At present the latter word is largely regarded as generic, that is, as applying to both uses of the machine. It is certain that in many cases, say at a factory, up to a certain stage of the construction, perhaps even when finished, there is no indication as to whether a given machine is to be used as a generator or motor. Even in the testing previous to shipment, the

machine may be tried in both ways. The final distinction comes only when the particular connections are made. If the machine is to be used as a shunt generator, say for charging storage batteries, a high resistance rheostat would be put into the field circuit. If it were to be used as a shunt motor, a low resistance rheostat would be put into the armature circuit; and if for variable speeds, a rheostat might also be used in the field circuit. A series motor is common for street car propulsion, but with the exception of their use for series street lighting, series generators are not often used. A compound wound generator is a very common sort, especially for railway generating stations. When such a machine, say in smaller size, is used as a motor, the terminals of the series coils should ordinarily be reversed, else they destroy the magnetism established by the shunt circuit. In general, the differences between the two are in the use rather than the construction. As a generator a somewhat higher speed than that realized with the motor is required. This allows for overcoming the various internal losses. The motor draws energy for these purposes from the supply circuit.

WINDING FOR A. C. MOTOR.

(30) A. S. B., Great Falls, Mont., asks:

Q. 1.—What size of wire should be used for winding the little alternating current motor described on page 79 of the July magazine, when the supply is at 60 cycles?

A. 1.—It would be permissible, and perhaps advisable, to use the No. 18 as described for the 30-cycle circuit. The article plainly states, however, that less turns be used. We would advise you to put on one size larger, but getting as many turns as the space permitted. One point of importance is not mentioned in the article, and that is to insulate the bolts that hold the laminations. Further, they should be of brass rather than of iron. Recognition of this detail will reduce the heating of the motor.

ARMATURE WINDING.

(31) W. E. VanB., Edgar, Neb., asks:

Q. 1.—What size and quantity of wire to use for an armature 1⅞" in diameter, 3" long, having 12 slots, each 5/16" dia., to adapt it for operating a jump-spark ignition coil? There are two permanent magnets.

A. 1.—As you do not state the present winding, or in what respects it now fails to operate, we cannot advise you as closely as desirable. It is certain that with the adjunct of an induction coil you can use dynamo current quite as readily as that from a battery. We advise you to use No. 22 double cotton-covered magnet wire, perhaps requiring ¼ lb. Get as many wires per slot as possible, each half-winding occupying one-half the slot, as is doubtless familiar to you.

REMAGNETIZING PERMANENT MAGNETS.

(32) J. B., Baltimore, Md., asks:

Q. 1.—How can I re-energize permanent magnets?

A. 1.—Find someone who has a 110-volt motor, bridge the magnets, one at a time, across the poles. This is to be done with the field excited, but the armature not running. If the starting rheostat does not in itself permit this condition, remove one of the brushes or slip a piece of paper between it and the commutator.

TOY ALTERNATING CURRENT MOTOR.

(33) B. F., Kittanning, Pa., asks:

Q. 1.—What would be suitable dimensions and winding for a toy alternating current generator, say to give 6 volts and 4 amperes, at 60 cycles? A machine with 6 poles is preferred, therefore permitting a speed of 1200.

A. 1.—Such a machine is almost too small to build, for a somewhat larger one would be just as easy. Years ago there were a number of 6-pole fan motors on the market, notably those of "Emerson" make. If through some dealer in electrical supplies or through some firm that repairs motors you could get one of these field magnets, it would be ideal for your purposes. Of course, you will have to excite the field magnet from some direct current source, and as you have not decided upon that we cannot advise you as to the size of wire or number of turns. The armature of the fan motor would be of no service, for you require one with at least 12 slots, using two adjacent slots for a coil. 24 slots would also answer, winding two coils per pole, one inside the other. For your proposed machine we would recommend an armature about 2½" in diameter and 1" long, axially, wound with No. 20 wire. We shall be glad to advise you more definitely just as soon as you have found out what materials are available.

FIGURING THE INPUT.

(34) E. W. S., San Francisco, Cal., asks:

Q. 1.—How to compute the watts in an electrical circuit when the volts and amperes are known, as, for instance, the input of a transformer?

A. 1.—Differing from the direct current case, the value of the watts cannot be determined merely by multiplying the number of volts and amperes. While methods involving the use of either three voltmeters or three ammeters can be adopted, they are by no means available for your purposes, and you should have recourse to an indicating wattmeter.

RADIO SECTION

Devoted to the Encouragement of Amateurs and Experimenters in the Field of Radio Communication.

THE TEST BUZZER AND ITS USES

Describing in Detail the Various Applications of an Electric Buzzer in Testing Receiving Apparatus.

By E. E. Bucher
Instructing Engineer, Marconi Wireless Telegraph Company of America

SINCE the advent of commercial wireless telegraphy, the simple bell buzzer has achieved a position of dignity and importance. No longer does this device alone adorn the wall of the butler's pantry and perhaps advise the presence of the unwelcome gas bill collector, but it becomes as well an invaluable asset to the radio experimenter for the preadjustment of a detector or the calibration of an oscillatory circuit.

At the time when self-restoring detectors were introduced into the art of radio telegraphy, necessitating the use of head telephones for recording purposes, it became apparent that there should be at hand some feeble source of high-frequency electrical oscillations for adjustment of the receiving detector to the maximum degree of sensitiveness; and it was early discovered that when any portion of a buzzer circuit (in operation) was placed in an inductive relation to the windings of a detector circuit, a faithful reproduction of the note of a genuine radio transmitter was effected.

It has, in some instances, been so thoroughly instilled in the mind of the junior experimenter that a high or perhaps well-nigh disastrous potential is required to radiate energy from an oscillatory circuit, that he does not at once grasp the fact that the desired results may be obtained even when the circuit is set into excitation by a feeble source of energy, such as two or three volts of battery current.

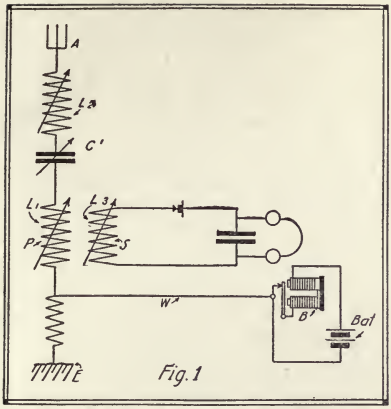
However, one fact cannot be denied; the amateur station minus this buzzer testing equipment is working at a distinct disadvantage and it behooves the owner to at once educate himself into its daily use.

For the benefit of experimenters of this class the writer will describe four distinct methods for employing the bell buzzer in connection with one or two cells of battery as a source of charging potential for excitation purposes, viz.:

(1) The plain buzzer excitation circuit.
(2) The aperiodic buzzer excitation circuit.
(3) The highly damped buzzer excitation circuit.
(4) The feebly damped or timed buzzer excitation circuit.

THE PLAIN BUZZER EXCITATION CIRCUIT.

In this, the first-named method, the buzzer is simply employed to locate the most sensitive spot on a detector of the crystalline type. It is most effective when employed as shown in Fig. 1. A small piece of insulated bell wire, *W*,



Wiring Diagram for a Buzzer Test Set Used in Finding Sensitive Spots of Crystal Detectors.

is connected to the stationary platinum electrode of the vibrator and then extended to and wrapped about the earth lead of the receiving tuner.

If the crystal to be adjusted is of the silicon or perikon type, it is quite sufficient that the lead be wound about the earth lead, but when carborundum is the detecting element, the wire may have to be bared and direct metallic connection made. The point of best adjustment is readily obtained; the buzzer being set into operation and various points on the crystal tried out until the maximum response in the head telephone circuit is attained.

The action of this device is as follows: When the buzzer is set in vibration—by means of a small battery current—an extra potential due to counter-electromotive force is set up in the windings and manifested as a spark at the platinum contacts. The wire extended from the stationary platinum electrode becomes one side of an open circuit oscillator, the windings of the buzzer the opposite side, which is charged by the extra potential and discharged at its own period of vibration, emitting highly damped, feeble oscillations of extremely short wave length.

The pulses of energy flowing in the extended wire act inductively on the aerial circuit, setting up in it similar pulses, which are again transferred to the detector circuit, wherein they are made audible. If desired, the extended wire *W* may be wrapped around some portion of the detector circuit winding in place of the earth lead.

Buzzers employed in work of this nature should emit a high-pitched note. It is now possible to purchase on the open market several makes having this characteristic.

A buzzer of any type may be adjusted for a high note if the platinum electrode of the soft iron armature is removed from the spring and fastened directly to the armature. There is the added advantage in this reconstruction that the buzzer is practically noiseless in operation.

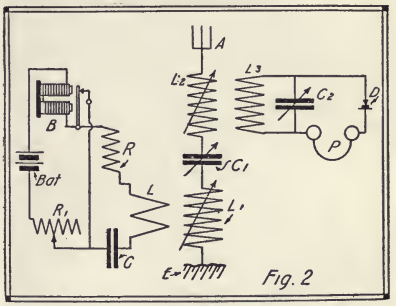
THE APERIODIC BUZZER.

The aperiodic buzzer excitation circuit is often used to give impulse excitation to a radio-telegraphic circuit upon which measurements are to be made.

A particular application of it is shown in Fig. 2, where the aerial circuit of a receiving set *L* 1, *C* 1, *L* 2, is to be calibrated.

An ordinary buzzer *B* has an aperiodic discharge circuit, *R*, *L*, *C*, shunted across the contacts of the vibrator.

The condenser *C* is charged by the counter-electromotive force of the buzzer windings, but the discharge through *L* and *R* is non-oscillatory owing to the resistance *R*. Thus the pulses of energy flowing through *L* may act inductively upon one or two turns of wire in the earth circuit, thereby charging the aerial system, which in turn discharges at its



Hook-up for Connecting Buzzer in Order to Give Impulse Excitation to a Receiving Set.

own frequency, as determined by the values of inductance and capacity employed.

Next a wavemeter, comprising the inductance coil *L* 3, the variable condenser *C* 2, the detector *D* and the head telephones *P*, is placed in inductive relation to some portion of the antenna system, being coupled as loosely as possible.

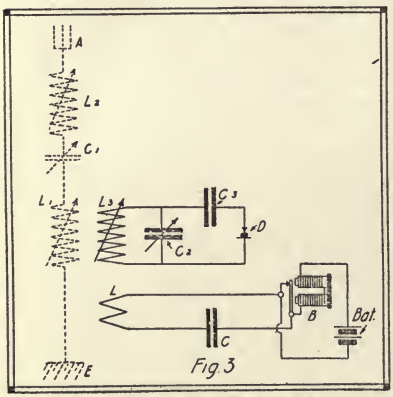
The buzzer being set into operation, the capacity of the wavemeter condenser is then altered until a maximum of response is heard in the head telephones; from which, of course, the wave length is directly obtained.

A number of settings of the aerial tuning inductance *L* 2, the short wave condenser *C* 1, and the primary winding *L* 1 may be made and the corresponding readings obtained on the wavemeter can then be tabulated or plotted in the form of a curve for future reference.

During the test the single turn of wire, *L*, should always be coupled as loosely with *L* 1 as is consistent with the strength of signals. The condenser *C* may have a value of about 0.004 microfarads and the resistance *R*, 600 to 900 ohms.

THE HIGHLY DAMPED BUZZER.

For simply finding the sensitive spot on a crystal, the so-called highly damped buzzer excitation circuit is of value.



Scheme of Connections for Using a Buzzer as a Generator of Highly Damped Waves.

In Fig. 3, *L* 1, *C* 1, *L* 2 constitute the antenna circuit of a receiving set, while the coil *L* 3 is the secondary winding connected to the detector *D*, etc. The test buzzer is represented at *B*, the battery at *Bat*. The vibrator of the buzzer is shunted by the condenser *C* and the single turn of wire *L*. The condenser *C* has a considerable value of capacity, say 1 or 2 microfarads.

When the buzzer is set into vibration, the circuit *LC* becomes charged by the counter-electromotive force of the windings, but the discharge of *C* is in the form of highly damped electrical oscillations, owing to the preponderance of capacity and the absence of any considerable value of inductance.

Regardless of the wave length to which the local detector circuit may be adjusted, it will be set into excitation by the testing circuit, and hence the best point on the crystal for rectification is readily located. Care should be taken to have the coil *L* in inductive relation to the *used* turns of *L* 3.

A number of receiving sets furnished to the United States Navy have been fitted with test buzzers of this type.

THE TUNED BUZZER TESTING CIRCUIT.

Of the methods described, the tuned buzzer testing circuit is the most desirable, and it is positively indispensable to the amateur experimenter who owns a wavemeter, for it not only serves the purpose of adjusting the receiving detector, but also permits the circuits of the entire receiving tuner to be preadjusted to the maximum degree of efficiency.

The complete circuits are shown in Fig. 4. As usual, the circuits of a receiving tuner are indicated by the variable elements of the antenna circuit *L* 2, *C* 1, *L* 1, *L* 4; the local detector circuit by *L* 3, *C* 2, *C* 3, *D* and *P*.

The wavemeter *LC* is set into excitation by the buzzer *B* in connection with the battery *Bat*, and thus becomes a miniature transmitting set, emitting oscillations of feeble damping.

It will be observed that, in order to complete the circuit, the battery current for the operation of the buzzer flows through the coil of the wavemeter *L*.

When the vibrator is in operation the rise and fall of the lines of force about *L* cause the condenser *C* to become charged, which in turn discharges through *L* at a frequency corresponding to whatever values of *L* and *C* may be used.

It is important, in order that the counter-electromotive force of the buzzer windings may be absorbed, that the magnets be shunted by a condenser of large capacity, say 1 microfarad, or this condenser may be conveniently replaced by a non-inductive resistance of about 100 ohms.

For preadjustment of the entire receiving tuner the method is as follows:

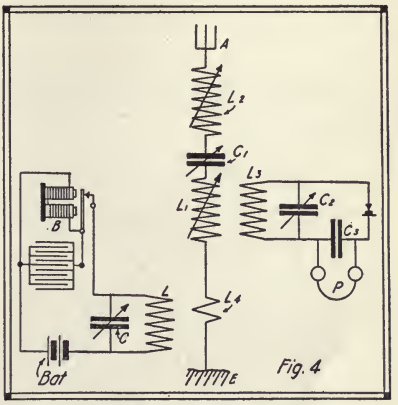
First, the secondary circuit of the receiving tuner *L* 3 is rather tightly coupled to the primary winding *L* 1, the condenser *C* 2 being set at the zero position. The coil of the wavemeter *L* is coupled to a single turn of wire, *L* 4, included in series with the antenna system.

With the buzzer in operation, high frequency electrical oscillations of a definite period traverse the wavemeter circuit and are then transferred by electromagnetic induction to the aerial circuit. These oscillations will have maximum intensity when the aerial circuit has the same value of wave length as the wavemeter. This condition is attained when the adjustable elements *L* 2, *C* 1, *L* are altered in value until a maximum response is secured in the head telephones.

The signals will have still greater strength when the local detector circuit *L* 3, *C* 2, is in resonance with the aerial circuit; this being accomplished when the values of these two elements are altered as necessary.

Resonance having been obtained, the detector may now be adjusted for sensitiveness, and, to do this most effectively, the coil *L* should be coupled as loosely as possible to *L* 4. Further trials at the detector are made until the maximum possible strength of signals is obtained.

It may be of interest to note here the relative sensitivity of certain of the various detectors. For instance, the writer finds that when silicon, perikon or cerusite detectors are employed the coil *L* must generally be within an inch or two



Connections for a Buzzer that Permits of Emitting Oscillations of Any Desired Wave Length.

of the coil *L* 4, but when a triple valve amplifier is the detecting element the entire wavemeter must be removed to a point fifteen or twenty feet away from the complete apparatus.

It will readily be seen why this method is preferable for the preadjustment of a receiving set, for when the receiving system is excited as a whole in this manner, account is taken of the degree of coupling between the primary and secondary windings, and accordingly the correct adjustment for the reception of signals of maximum intensity is given.

It should not be forgotten that the wavemeter must have such values as to be within the range of the set to be calibrated, and if satisfactory results are not obtained it may be due to the lack of proportion between the circuits.

A minimum value of battery current should always be employed for the operation of the buzzer. It might therefore be advisable to include a small battery rheostat in the circuit as indicated in the drawing. Should it be desired to calibrate the secondary winding alone, the antenna circuit may be disconnected and the coil of the wavemeter *L* placed in inductive relation to the secondary winding *L* 3. The constants of that circuit may then be varied and the corresponding wave lengths noted on the wavemeter where maximum response is secured.

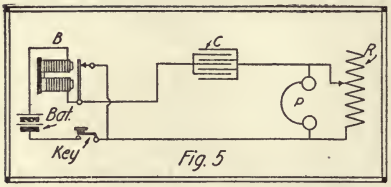


Fig. 5

Connections for a Simple Buzzer Practicing Set That May be Used in Learning the Codes.

Last, but by no means least, we may mention the use of the buzzer for instruction in the telegraph codes. As a learner's practice device it has no equal. A diagram of connections is shown in Fig. 5, where an ordinary buzzer, *B*, is connected to the battery, *Bat*, in connection with the telegraph key, *K*. The circuit containing the telephones, *P*, the condensers, *C*, and the battery rheostat, *R*, is shunted across the contacts of the vibrator.

The key being closed and the buzzer properly adjusted, a high-pitched note is produced which may be regulated to imitate any type of radio-telegraph spark transmitter in use today.

For "fulness" of tone the condenser *C* should have a capacity of the order of 2 microfarads, and the rheostat R a maximum value of resistance of about 10 ohms.

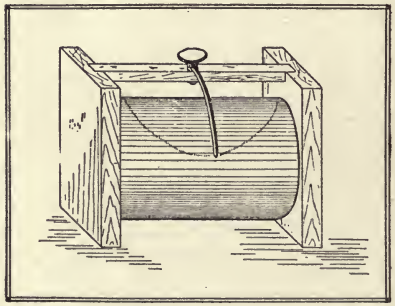
The use of the reheostat *R* will soon become obvious, because sufficient energy is released from the condenser *C* to operate several hundred head telephone receivers and, of course, in a single telephone without the rheostat the sounds would be of unbearable intensity.

Finally, the writer finds that there is some misunderstanding as to the number of interruptions which can be obtained per second by a buzzer. Certain high-pitched buzzers constructed particularly for radio-telegraph apparatus will give a frequency of vibration of from 1000 to 2000 per second.

A RAPID ACTION SLIDER

In the accompanying sketch is shown a type of slider that can be used advantageously on tuning coils of average length and large diameter.

In the center of the slider bar of a tuning coil bore a hole of a suitable diameter to pass an 8/32 machine screw.



This Simple Arrangement Permits of Greater Ease and Rapidity in Tuning.

Then take a piece of phosphor-bronze or springy brass strip of about one-half the length of the tuning coil. At one end bore a hole through the strip to hold it on the screw that passes up through the hole in the slider bar, by means of two nuts. Bend the other end of the spring and round it off so that it will slide over the wire without binding. Place a suitable knob on the end of the screw and the slider is complete.

Such a slider as described in the foregoing is far simpler to adjust, a mere turning to the right or left being all that is necessary.—NATHAN WOLPERT.

NEWARK RADIO CLUB

The Newark Radio Club has recently been organized by young men residing in and near Newark. All amateurs in the vicinity who are interested in radio telegraphy are urged to join the association. Communications should be addressed to the secretary, David S. Cohen, 369 Morris Avenue, Newark, N. J.

AMATEUR WIRELESS STATIONS

THE STATIONS AND APPARATUS IN THE ABOVE VIEWS ARE AS FOLLOWS: (1) Wireless Station of Paul Robillard, New London, Conn. (2) Wireless Station of J. D. Haig, Merchantville, N. J. (3) Receiving and Sending Set of H. Corcell Stuart, St. Johnsbury, Vt. (4) Experimental Apparatus of Dale Laughlin, Sioux City, Iowa. (5) Wireless Station of Edmond B. Carr, Springfield, Ill.

An Efficient Transmitting Condenser

By C. L. Sears

THE average glass plate condenser does not give good service since losses due to brushing are great. A glass plate condenser immersed in a good grade of transformer oil, using copper foil or sheet, has been found to be nearly as good as a compressed air condenser, without the high cost and bulky appearance of the latter.

The condenser described in this article will be found suitable for any ordinary amateur set up to one kilowatt when using a wave length of 200 meters. The variable and adjustable feature will be appreciated if one desires to use the full power at all different adjustments of the oscillation transformer. Very often a transmitting outfit using a one kilowatt transformer will not give an antenna reading of more than 2½ to 3 amperes, due to the incorrect capacity of the condenser, which does not absorb full power; whereas, if the condenser were the correct size it would take the full power and the antenna would show 5 to 6 amperes on the hot-wire ammeter.

The condenser about to be described has a very wide range, namely, from approximately .00005 to .0199 mfds., and consists of one variable portion with a maximum of .00342 mfds., and an adjustable portion of three units: One of .00206 mfds., one of .00412 and one of .0103 mfds. The variable portion is made after the manner of a receiving variable condenser of the rotary plate type with the exception that it is somewhat larger and uses transformer oil as a dielectric instead of air.

It is particularly in wireless telephone work that this condenser will be found very useful, since it possesses the variable feature combined with high insulation that is proof against break-downs.

In Fig. 1 are shown the various parts of the variable condenser. The plates (see *A* and *B*) are cut from 1/16 inch aluminum or copper sheets to the sizes given. Twenty of the plates shown at *A* and nineteen like *B* are required. After being cut to size and drilled out as shown, the plates should be made perfectly flat by hammering them with a leather mallet. Two pieces for connection should be made as shown at *J* and *K*. The piece *K* is drilled for the same sized holes as the stationary plates, *A*, while the piece *J* is merely a flat strip.

The dimensions for the washers are given at *C* and *D*, cut from round brass rod. There are required 18 like *C*, cut from ¾-inch round rod, and 57 like *D*, cut from ½-inch round rod, all 5/16 inches long. Also while making these washers there should be cut three pieces 1 inch long, ½-inch diameter, and threaded for 10-32; six pieces ¼-inch long and ½-inch diameter, threaded for 10-32; one piece 1 5/32 inches long, ¾-inch diameter, threaded for 14-20; one piece 13/32-inch long, ¾-inch diameter, threaded for 14-20; and one piece ¼-inch long, ¾-inch diameter, threaded for 14-20. These last pieces will serve to hold the various parts together.

The rods for holding the plates comprise three pieces of 3/16-inch round brass rod, *E*, threaded for 10-32, and one piece of ¼-inch round rod 11½ inches, and threaded for 14-20, as shown.

The handle for turning the rotary plates is shown at *G* and is made from ¾-inch black fiber and drilled half-way through the center with a 3/16-inch drill and tapped out with a 14-20 thread. The pointer is made from a short piece of No. 12 aluminum wire driven in the handle, the end being flattened and cut to a spear head form with a pair of shears. The part shown at *H* is used as a bearing for the handle and is made from 1-inch round brass rod, threaded for 14-20.

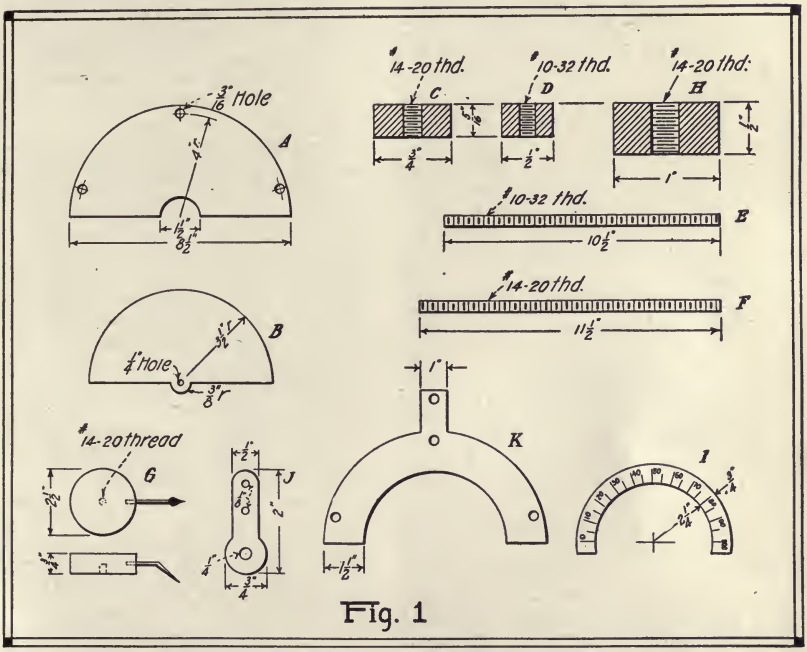
The scale or dial, *I*, is made about 6 inches in diameter and a trifle more than a semi-circle. If the maker has not a set of numbering dies, the dial may be etched with nitric acid by first coating it with melted beeswax and scratching through. A small quantity of acid is then placed in the scratches. When etched deep enough the acid may be washed off with

ammonia, and by heating the plate the wax may be wiped off with a rag and the plate can be polished and lacquered.

A piece of ¾-inch black fiber should be made the same size as the plate shown at *A*, except that the center should not be cut out and it should be about 1 inch greater than a semi-circle. Through the center is drilled a ¼-inch hole. This is

The condenser electrodes are made as shown at *A*, Fig 2, and are cut from copper foil or thin, soft copper sheet. The condenser is built up as shown at *B*, Fig. 2, and connected as shown at *C*. The sections are as follows:

First section, *C*, 1 and 2 plates.
Second section, *B*, 2 and 3 plates.
Third section, *A*, 5 and 6 plates.



Various Parts of the Transmitting Condenser, Including Stationary and Rotary Plates, Washers, Rods, Handles, Dial, Connecting Piece and Base Plate.

to be used to hold the plates in their proper places at the bottom of the jar. This completes the variable condenser.

In the adjustable portion of the condenser, the glass used for separation consists of 22 pieces cut from old photographic plates that have been thoroughly cleaned. The glass plates should measure 8 by 14 inches and be ⅛-inch thick. Double strength clear window glass, free from flaws, may be used although not so good; also, the capacity would be reduced about 25 per cent.

There should be two pieces of glass set between each section for better insulation of the electrode leads or tabs. After the condenser has been built up as shown, it should be tightly wrapped with some flat cotton or silk tape.

In Fig. 3, the switches for throwing in the various sections of the condenser are shown. These consist of six small 15-ampere baby knife switches of the S. P. S.T. type, removed from their porcelain bases, and two copper strips drilled as shown at *D*. There should also be in-

cluded two heavy "quad" style binding posts. The size of the holes through which the switch posts pass in the strip are not given, as they will vary according to the make of the switch used. The smaller holes for the wood screws should be about ⅛-inch to accommodate a No. 4 round head brass wood screw.

Two battery jars, 9 inches in diameter and 15 inches high will also be needed to hold the oil, as it is practically impossible to make a wooden box oil-tight.

The condenser may be mounted in two different ways, either making two separate units or as one piece of apparatus. A box to hold the two jars may be made of walnut, mahogany or oak, the most suitable stock being about ⅞ inches thick. Walnut and mahogany are the best insulators, but oak is easier to finish.

If made of ⅞-inch stock the box will require:

2 pieces ⅞" x 12" x 21½"
2 " ⅞" x 15¼" x 20½"
2 " ⅞" x 9¼" x 15¼"

This will give a box 9¼x15¼x18¾ inches inside, and will allow for square-end corners as shown at *A*, Fig. 4. The box should be put together with 1½-inch flat head brass screws. If of oak the box should be given a coat of filler and then waxed. It may also be stained if desired. If made of mahogany or walnut it should be varnished and then rubbed down to a piano finish with pumice stone and water, and finally with rotten stone and oil.

The condenser is now ready for assembling, but before starting on this work, the front and top of the box should be taken off.

The three pieces that are 1 inch long and ½-inch diameter, threaded 10-32, should be screwed down on the long threaded end of the 3/16-inch rods until 1⅛ inches of rod sticks through the other end. The stationary plates are then placed on the rod with the separating washers between, beginning with a plate and ending with a plate. The whole is tightly held

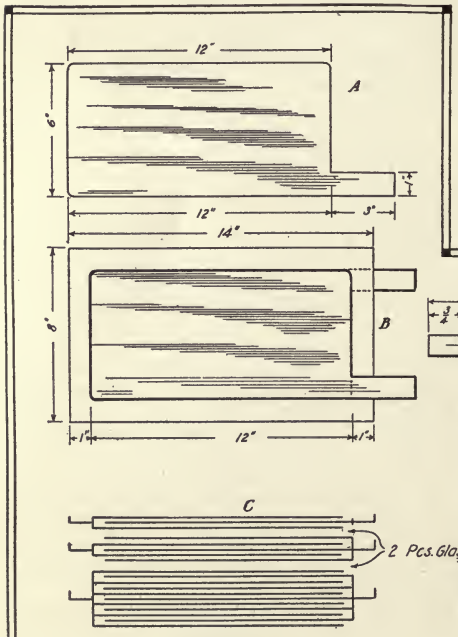


Fig. 2

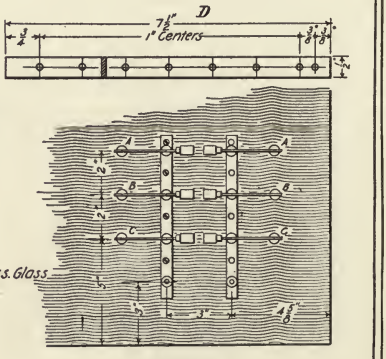


Fig. 3

The Fixed Condenser Member of the Transmitting Condenser, Showing the Arrangement of the Units and the Switch Construction.

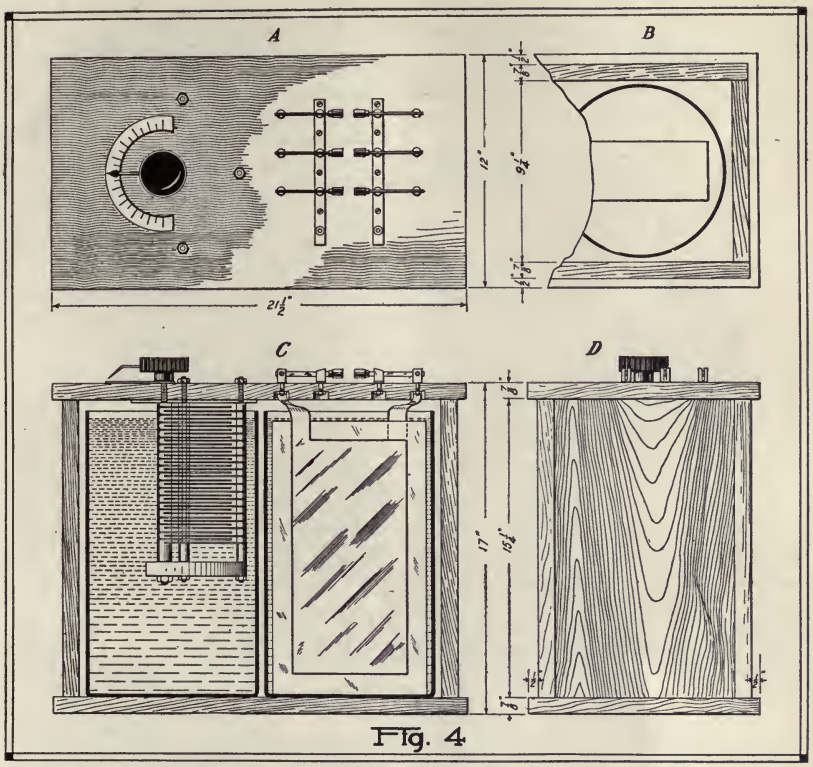


Fig. 4

Views of the Complete Transmitting Condenser which May be Used to Good Advantage in Wireless Telephone Work.

together with a ¼-inch brass nut threaded for 10-32.

The ¾-inch diameter piece, 1 5/32 inches long and threaded 14-20, should be screwed on the long thread end of the ¼-inch rod. On this rod are assembled the movable or *B* plates, starting and ending with a plate and using the ¾-inch washers as separators. The whole is tightened by screwing on the 13/32-inch, ¾-inch diameter, 14-20 piece. The upper end—the long threaded end—should protrude through the 1 5/32 inch ¾-inch nut about 1⅝ inches.

The black fiber piece ¾-inch thick should then be placed on the lower end of the fixed plates and clamped in position with the other three ¼-inch long, ½-inch diameter pieces, one on each 3/16-inch rod, and the ¼-inch, ¾-inch diameter piece put on the end of the ¼-inch rod and then soldered in place so that the rotary plates turn easily in the fiber. The pieces *J* and *K* should then be slipped over the upper end rods; the piece *K* over the fixed plate rods and the piece *J* over the upper end of the rotary plate rod, so that when tightened against the inner part of the box top they may be used for connecting the variable section to the two quad binding posts on the copper strips (see Fig. 3) by means of flat copper tape.

The fixed plates may be fastened to the top of the box by boring three holes as shown in Fig. 4 at *A* and *C*, and plac-

ing three finishing nuts on the rods; the rotary plate rod being placed through the box top also and the bearing *H*, Fig 1, screwed down with the handle over it. The dial may be put in position with about five small ¼-inch round head brass screws.

The parts shown in Fig. 3, should then be mounted on the other end of the box tops and the connections from units *A*, *B* and *C* (Fig 2-C) made to posts *AA*, *BB* and *CC*, shown in Fig. 3.

The jars should then be placed in the box and the top of the box put in place, thus at the same time lowering the variable and adjustable sections into the jars. The front of the box should not be put on until the jars have been filled to within ½ inch of the top with transformer oil, about 3⅛ gallons being required for this purpose. The oil should be put in with the aid of a funnel and about two feet of rubber hose.

The range of the condenser using the variable section only at a maximum is as follows:

Calling the 1 and 2-plate section of .00206 mfd. "*C*."

Calling the 2 and 3-plate section of .00412 mfd. "*B*."

Calling the 5 and 6-plate section of .01030 mfd. "*A*."

Calling the variable section of .00342 mfd. "*V*."

$C. = .00206$ mfds.
$V. = .00342$ "
$B. = .00412$ "
$C + V. = .00548$ "
$B + C. = .00619$ "
$B + V. = .00754$ "
$B + C + V. = .00950$ "
$A. = .01030$ "
$A + C. = .01236$ "
$A + V. = .01372$ "
$A + B. = .01415$ "
$A + C + V. = .01578$ "
$A + B + C. = .01648$ "
$A + B + V. = .01784$ "
$A + B + C + V. = .01990$ "

As V. is only considered a maximum value, it can be seen that many values between those here given can be obtained by either reducing V's value, by rotating the plates, or by substituting it for C and reducing below C's value.

HOW RADIO WAVES TRAVEL THROUGH THE EARTH

PROFESSOR MARCHANT, the English physicist, recently wrote in the London *Electrician* that unless two sets of wireless waves—which travel through the earth as well as through the air—are really one, there would be serious "back flaring" of the secondary waves.

Dr. Fleming, another British engineer, also used the expression "waves due to surface electricity propagated in or through the earth."

Now comes Professor G. W. O'Howe, who seeks to disprove that electro-magnetic waves can go through the material of which the earth's crust is composed and then to give rise at a distant point of the earth's surface to phenomena which have usually been assumed to be entirely due to radio-waves that have travelled through the atmosphere and the outside space.

He says the earth's crust merely acts as an imperfect conductor to the radio-wave currents with which such waves must be associated if they are to travel around the earth and not pass off into space.

The specific capacity of induction and resistance in ohms for the cubic centimeter for sea water, fresh water, damp earth and dry earth, are all known, so the values can be obtained for the high frequencies employed in radio-telegraphy.

Professor Howe's conclusions after a detailed investigation are these: He found that a wave in the earth itself cannot persist far beyond the surface for any great distance unless it travels through the crust and is at the same time continuously supplied with energy from the main wave in the atmosphere above.

Long distance transmission, according to experiments between the Arlington Station and such large scout ships as the *Salem,* cannot be due to waves through the earth or the sea.

The current received at a great distance, when it is calculated upon the assumption of a perfectly conducting earth and an un-ionized atmosphere, is shown to be much smaller than that actually found by Dr. Austin. This is the basis for the theory of reflection of radio-waves by refraction due to ionization of the upper and outer layers of the rarified atmosphere.

The effect of the curvature of the earth in long-distance radio-telegraphy has been investigated by many mathematicians, notably Poincaré, Hurlbutt, Cohen, March, Meholson, and Sommerfeld. W. Von Rybczynskii, at work under Professor Sommerfeld of Munich, has just published a severe and correct arraignment of Poincaré's and Nicholson's results on the ground that their approximations were such as to lead to large errors.

They assume a perfectly spherical earth and a perfect conductor surrounded by perfect insulation. None of these assumptions is correct, hence their solution for practical wireless telegraphy is useless.

NEW POCKET RADIO SET

At frequent intervals we hear of someone picking up signals with a pocket radio set attached to an ordinary umbrella held in the hand for an antenna. But the particulars concerning the precise type of apparatus used are for the greater part rather vague.

In the illustration is shown the appearance of a complete receiving set which for compactness seems to be all that may be desired. The set comprises a head band and receiver attached to a small cylindrical case not much larger than a good sized pill box. In the latter may be found a detector, fixed condenser and tuning coil of diminutive size. The variation of the inductance of the tuning coil

A Pocket Wireless Set Containing a Tuning Coil and Crystal Detector.

is accomplished by means of an instrument switch bearing upon contact points connected with the turns of the winding.

Notwithstanding its extreme compactness, the set appears to be decidedly practical in design and the various parts are arranged so as to provide a unit of great convenience in operation and, it would seem, of an efficiency commensurate with its field of application. The set should prove of not a little value to the camper or boy scout in the field, or in any case where a light and extremely portable outfit is essential.

CENTRAL RADIO ASSOCIATION

The recently organized Central Radio Association is enjoying a healthy increase in membership, and the secretary reports that the association is now represented in twenty-four States. The primary object of the association is to further the acquaintance among the amateur operators residing in the States lying between the Rocky Mountains and the Ohio River.

There is no entrance fee in the asso-

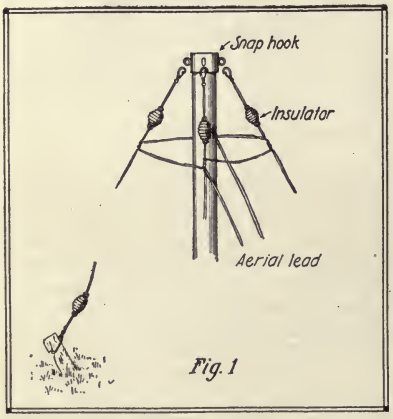
ciation and all amateurs or clubs of amateurs in the district are invited to join. The secretary of the association, H. B. Williams, Chanute, Kansas, will be glad to forward application blanks to those who are interested.

NOTES ON PORTABLE WIRELESS SETS

THERE is nothing that will afford more real interest for the wireless enthusiast than the possession of a really efficient portable outfit, and likewise there is nothing that will tax his ingenuity more than designing the same.

It is obvious that in the construction of a portable set a great number of problems arise which are not met with in a permanent station. Primarily, the equipment must be light, rugged, compact and, at the same time, efficient. The containing case should be comparatively small, and the antenna system and source of power for the transmitter should be packed in such a manner that a minimum of time and labor is consumed in setting up the apparatus.

All of these features are combined to a marvelous degree in the field radio set used by the U. S. Army. This outfit, of course, incorporates some apparatus that is beyond the average experimenter's means, but there are several features that can be profitably patterned after in any amateur equipment. Many descriptions of such portable sets have appeared in past issues of this and other periodicals.

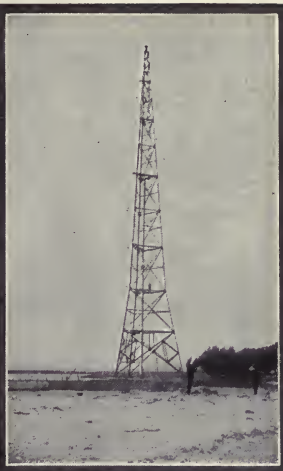


Method of Attaching Aerial Wires to the Top of a Portable Wireless Mast.

But to return to the construction of an amateur portable outfit. The first question that arises is the design of the antenna system. The type of aerial used is determined largely by the nature of the work the set is intended to perform. If the station is to be set up at a camp, a more or less permanent aerial can usually be erected. The construction of a horizontal aerial is, of course, advisable where practicable, but a slanting one suspended from a tree or flag-pole and with the lead brought in from the lower end is very serviceable. However, in most instances, a "take-down" mast constructed in six foot sections with metal connecting sleeves is the only practical solution. For use with such a mast, an "umbrella" aerial is preferable to all other kinds, because it has no directional effect and the wires themselves form the guys for the pole. Each strand is terminated at both extremities by a ball insulator, and all the top ends are soldered at intervals to a lead which is brought down to the instruments. Provision is made at the lower ends of the wires for securing them to stakes, and the upper ends are terminated by snap hooks, which can be quickly fastened into rings on the top mast section. When the outfit is taken down, the antenna wires are detached from the poles and stakes, and each one rolled up separately; the top ends remaining connected to the lead-in and enabling the aerial to be erected without loss of time. The sketch shows the scheme clearly.

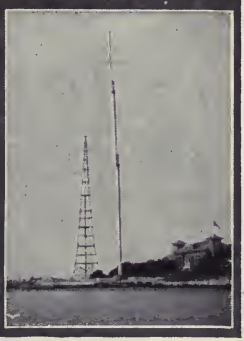
An efficient ground connection is of as much, if not more, importance than a good aerial, and presents a more difficult

(*Continued over leaf*)



Various Views of the Beaufort, N. C., Station Before the Erection of the Steel Tower, and as It Appears To-day.

THE BEAUFORT STATION

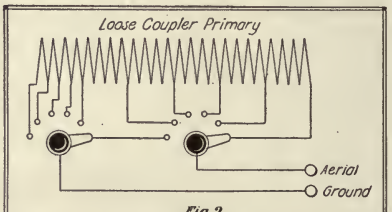


The above views show the former wooden masts used at the Beaufort, N. C., wireless station and the present steel masts. The Beaufort station is situated on Piever's Island and belongs to the Navy. Some three years ago the wooden mast fell and crashed through the roof of the building housing the U. S. laboratory, in a ninety-mile gale. Since that time the wooden mast has been replaced by a three-sided steel tower resting on a concrete foundation.

problem. A generous sized piece of sheet zinc solves the problem if the set is to be erected near a creek or well, but this does not include the majority of cases. If the station is designed for use in all locations and under any conditions, any sort of attempt at a direct ground connection is likely to be unsatisfactory. With this idea in view, a "counterpoise" may be used in the form of several lengths of rubber insulated copper wire, which are laid out on the ground radially from the mast and all connected at the center to the ground lead. A number of lengths, equal to the number of aerial strands, of wire such as is ordinarily used for light current transmission, will serve the purpose. In this scheme, there is no positive ground connection, but a condenser effect is produced. Such a "ground" has been found to operate very satisfactorily and has the advantage of being conveniently portable.

The elaborateness of the receiving set naturally varies according to whether the portable outfit is to be equipped for both sending and receiving or only the latter. In any case, the tuning device should by all means be of the loose-coupled type with switch adjustment on both coils. The primary inductance should be variable by not more than two turns at a step for accurate tuning, which can be accomplished with a small number of contact points by the double switch arrangement shown in Fig. 2. The right-hand knob varies the inductance in large steps, and the adjustment is then perfected with the left-hand knob, which controls a number of turns in all equal to the number of turns included between two contact points on the first switch. This connection gives the fineness of adjustment of the time-honored slider, with none of the poor contact resulting therefrom.

The United States radio pack set uses a zincite-bornite detector, but the common little silicon type is probably best suited to the amateur's purpose. For practical work the use of a good, sensitive pair of at least 1,000 ohm 'phones is imperative.



Simple Form of Tuning Apparatus That May Be Used to Good Advantage in a Portable Wireless Set.

The remainder of the apparatus may be essentially of the usual permanent station type, but contained in a compact unit. A sensitive receiving outfit will go a long way towards overcoming some of the unavoidable handicaps resulting from the limited antenna system.

The greatest difficulty encountered in the transmitting set is the obtaining of an efficient source of power for the transformer or coil. The U. S. Army sets employ "take-down" 500 cycle generators run by hand power applied to two large cranks. The little alternator is a marvel of efficiency, but far beyond the average experimenter's pocketbook, leaving him the sole choice of batteries. The next best, then, is probably a good storage battery, carried in a separate case and provided with a flexible lead so that it can be rapidly connected to the transmitting apparatus of the portable set.

The direct current power will make some sort of interrupter necessary, which at best is a more or less troublesome piece of apparatus. A spark coil having a vibrator with ample sized platinum contacts will usually work satisfactorily, but if more power is used on an open core transformer, the construction of an independent magnetic vibrator is advisable.

The design of the secondary circuits should make up for some of the inadequacies of the antenna and power source. The most efficient gap to use is probably a small one of the quenched type, which will prove efficient despite its "mushy" tone caused by the conditions. A series gap with large sparking surfaces is the next best solution, unless the resourceful amateur devises some way to use a rotary gap advantageously under the unfavor-

able circumstances. The closed oscillating circuit should be loose coupled to the open radiating circuit to prevent any undesirable "back induction" between the two. To save space, the secondary may be closely wound of small strip, so that it can be slid entirely inside the primary spiral, which accordingly should be of broad strip and large diameter, the whole being placed in the lid of the case.

A "break-in system" with a gap in the ground lead will save the space of a switch and increase the rapidity of sending and receiving signals.

The arrangement of the instruments, packing for transportation and other similar features are important details that can only be satisfactorily determined for any one set, however, by the owner himself.—M. K. ZINN.

The Marconi Station at Belmar, N. J.

WIRELESS messages can now be flashed from New Jersey to London. With this feat accomplished, we see the completion of one of the links of the wireless girdle of the world by the Marconi Company: From New Jersey to London, from London to Egypt, from Egypt to India, from India to Yokohama, from Yokohama to Honolulu and from Honolulu to San Francisco. Messages will soon be flashing both day and night in their course around the earth. The two stations in this country and the one in Honolulu were erected by the Marconi Company at a cost of a million and a half dollars, and are said to be larger and more powerful than any other wireless stations in the world.

The stations for the Atlantic side of America have been built in New Jersey; the receiving half being in Belmar and the transmitting portion in New Brunswick, although both parts will be controlled at Belmar by the use of a telegraph line, working the high power transmitting keys at the sending station in New Brunswick through automatic relays. Thus, all the operating will be done at the receiving station, while the actual energy will be emitted from the transmitting station at New Brunswick, about twenty miles distant.

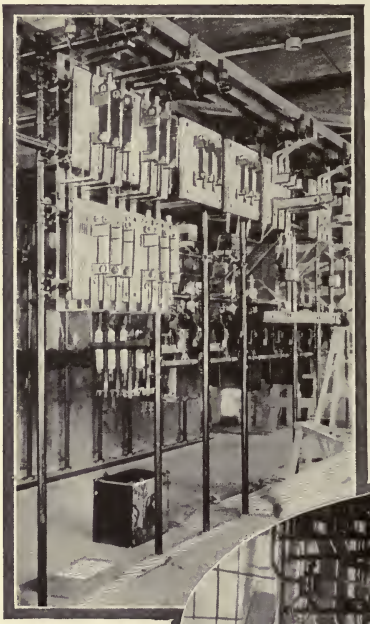
The company is using high speed automatic transmitters of a synchronous rotary discharger type of 300 kilowatt rating, with a capacity of about 100 words a minute. In addition to using high speed automatic transmitters, the receiving will also be done automatically and the messages will be taken down on a dictaphone, at the same time giving a permanent record of all communications.

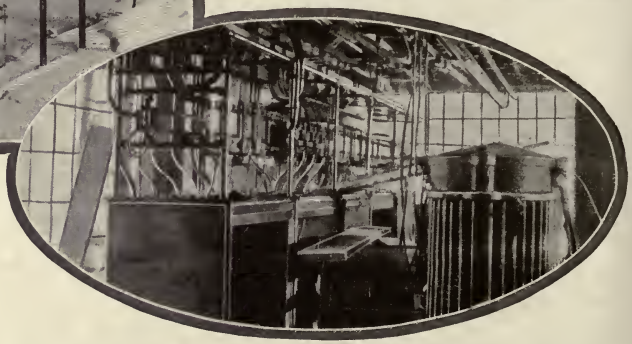
The actual sending distance is 3000 miles and the length of time required to send a signal across the ocean is slightly less than one-fiftieth of a second. Messages are handled normally at Belmar, both outgoing and incoming, all Western Union telegraph stations acting as feeders for Trans-Atlantic Marconigrams over land wire connections from New York to Belmar. At Belmar the messages are fed to automatic machines, which, by means of auxiliary circuits, operate the discharger and hence the aerial at New Brunswick, where the actual sending impulse is released. The incoming wireless signal, on the other hand, is read directly at the Belmar aerial. Belmar is tuned in harmony with the sending station in England, but out of harmony with New Brunswick or its own sending impulse. Similarly, the receiving station in England is in harmony with New Brunswick but out of harmony with its own transmitted wave; the reason being, of course, to permit each receiving station to hear signals from across the ocean through the simultaneous disturbances of its own sending.

The current used for sending the messages from the New Brunswick towers is supplied by the Public Service Electric Company from their sub-stations in New Brunswick. A direct line from the

sub-station to the Marconi plant—a distance of four miles—furnishes electricity at 2400 volts, 60 cycles. At the Marconi station it passes through transformers and is boosted to 100,000 volts and 19,000 cycles at the aerial. The total equipment of the station is 650 horsepower, normal rating.

It is interesting to note that all the wireless stations are being supplied with





In the Accompanying Illustrations Are Shown Portions of the Transmitting Equipment at the New Brunswick Plant. At the Left: Rear View of the Main Switchboard. Below: Switching Cells for Incoming High-Tension Lines.

Central Station current, with the single exception of the station in Hawaii, where it was necessary for the Marconi Company to build a power plant of their own in which were installed three 500-kilowatt steam-driven turbines.

Work on the New Jersey stations was started in May of 1913 and completed July, 1914. It is estimated that 28,000 tons of heavy material was used in the construction of the transmitting half of the station, and that 26 tons of imported glass was used in the tanks of the condenser at the New Brunswick plant.

An interesting feature is the construction of the iron masts which hold the aerial wires. The towers that the other stations in the world-girdling chain use differ in length and number according to the wave length employed, the distance over which transmission is desired and other local conditions. The New Jersey transmitting station at New Brunswick has 13 masts 430 feet high, supporting a network of silico bronze wires over a mile long. The masts consist of tubular sections of steel, surmounted by a wooden top mast extending above the steel structure, the whole standing on a concrete foundation. The masts are supported by stays that are anchored in a steel crib embedded in a heavy block of concrete. The main portion of the mast is built of composite steel cylinders, each made up of four-quarter sections flanged vertically and bolted together to form the cylinder. This method of construction enabled the rapid erecting of the masts, which are small in diameter compared to their height and offer little resistance to the wind. A single mast consists of sixteen cylinders 15 feet long, one tapering section 10 feet long and then

follow fifteen cylinders 10 feet long, making the total height of steel work 400 feet, and above this raises the top mast of 30 feet. The wooden top mast is the key of the novel system of construction, because it acts like a man who pulls himself up by his bootstraps.

It is remarkable that not one workman was seriously injured in the construction of the New Jersey stations, although the construction of the masts had no precedent even for the engineers.

There are 12,000 feet of exceptionally high tensile strength wire rope, made of even strands of seven wires each, used to stay each mast. Each stay wire is broken up into a number of short lengths by porcelain insulators to prevent absorption of energy by the wires, which would occur if any length was long enough to have the period of vibration similar to the wave length of the sending station.

At the Left: Power House at New Brunswick in Course of Construction. In the Oval: Auxiliary Operating Building at New Brunswick.

At the Right: Foot of the Aerial, Where the Lead-in Wires Are Brought Into the Transmitting Station. There Are Thirty-two Wires in All.

AUTOMATIC TELEGRAPHY.

The Associated Press has just installed in the New York editorial rooms an automatic telegraph system employing what are known as Morkrum telegraph printers. Not only do these printers save much time, but they eliminate telegraph operators. It is said that a good Morse operator is capable of handling two thousand words, while the Morkrum machines will handle no less than three thousand. Briefly, it may be stated that the Morkrum system employs a paper tape that is perforated on a machine resembling a typewriter. Messages are printed at the receiving end of a roll of paper, in such a form as to be read by anyone. In newspaper offices a system of this kind is bound to prove a great time saver.

If you enjoy THE WORLD'S ADVANCE, tell others; if not, tell us.

What the World is Doing

"JUST what field do you cover and how do you aim to do it—in other words, what is the policy of your magazine?" is the question asked the editors almost daily by the uninitiated. And a natural question it is, for the policy which is meeting with universal approbation among our readers, both new and old, is too young and perhaps too radical to be perceived at first glance.

Our answer is invariably in the nature of a comparison with other magazines purporting to be in our own field; there are some excellent publications which tell the reader all that is going on in the world of electricity and mechanics and there are others that tell, in highly technical language, how the results are accomplished. The aim of THE WORLD'S ADVANCE is to tell the everyday man not only what is going on, but *how it is done*, and this in terms so simple that he can readily comprehend the plan. The object of this is to enable the multitude to profit by the experience and ingenuity of perhaps a few bright men.

The articles in the magazine are never so long as to be wearisome, but neither are they so curtailed as to merely whet the appetite of the reader, leaving him with his curiosity wholesomely aroused but totally unsatisfied. In editing the manuscript the irrelevant matter is invariably weeded out and lengthy dissertations that may possibly have the merit of verbosity—if merit it is—find no place in our columns. The length of the "newsy" portion of the article is governed solely by the story the author has to tell, without regard for the number of pages consumed; and, when the interesting facts of the matter are told as a matter of news, we take enough additional space to tell the reader how the trick was done.

Perhaps the casual reader will say, "That sounds very well, but now back it up." To this we suggest that the skeptic turn to any feature article in this or any other number. Take, for example, Mr. Skerrett's offering on page 603 of the present number; in this article the author tells of the ever-present danger of a shifting cargo in a ship at sea. He shows how an accident of this kind may happen on a freighter laden with a valuable cargo and perhaps result in the loss of the lives of the crew and the entire cargo as well. As the reader follows the story, which is replete with interest in itself, he will note that the exact method of procedure by means of which the cargo was righted and the vessel brought safely to port is related in minute detail. Perhaps the radio amateur or the handy-man-about-house will say, "Of what earthly use can it be for me to learn how to right a shifting cargo in a ship at sea?" To this we say let the reader not lose sight of the fact that the value of any piece of knowledge lies not in the concrete application which served to illustrate the plan but in the elementary principle involved. For example, we learn in school that there is such a thing as capillary attraction. How many of us remember ten years later that we ever heard of such a thing in the physics class? And yet when we go to pour a liquid out of a tumbler and into a bottle without the aid of a funnel we are likely to spill the liquid unless we utilize that simple physical principle, capillary attraction. If we place the handle of a spoon, a piece of wire, or a glass rod at the edge of the tumbler the liquid will pass down the rod and into the small neck of the bottle without a drop being spilled. The formidable sounding capillary attraction causes the liquid to cling to the rod as it passes into the bottle.

The homely illustration thus afforded may serve to suggest that any easy way of surmounting a difficulty, no matter how foreign it may seem to our own walk in life, is worthy of note if we but comprehend the simple principle involved. In Mr. Skerrett's article we learn that a shifting, mushy cargo of semi-fluid asphalt was prevented from surging about and acting as a battering ram on the interior of a vessel merely by letting down a simple weighted plunger into the center of the mass and thus causing the level of the latter to rise until it reached the under side of the deck.

Short Circuits

"He who puts his hand to the plow," screamed the cross-roads orator, "must not turn back."

"What is he to do when he gets to the end of a furrow?" asked the auditor in the blue jeans overalls.—*Christian Register.*

Restaurateur—Anything the matter with the chowder, sir?

Guest—Oh, no. I was merely wondering how in the world you ever discovered so many things cheaper than clams to put in it.—*Judge.*

Financier—That is not the same tale that you told me a few days ago.

Beggar—No, sir. But you didn't believe that one.—*London Mail.*

"Why are you moping there, Dick?"

"I've no one to play with."

"Well, go and fetch Freddie, next door."

"Oh, I played with him yesterday, and I don't suppose he's well enough to come out yet."—*London Opinion.*

Wife—I've noticed an odd thing, John. When you go to light the gas in the next room you invariably take two matches.

Hub—Yes, my dear; I long ago discovered that if you carry one match it will go out, while if you carry two it won't.—*Boston Transcript.*

"Yes, I tried the experiment of an office girl instead of an office boy. She didn't whistle or smoke, but she failed to please the office force."

"Why was that?"

"She could never learn to go out and get the correct score."—*Kansas City Journal.*

"Have you any parts of an automobile that you don't want?"

"I have an old tire. What's the idea?"

"You know how our grandmothers used to make crazy quilts for the needy?"

"Yes."

"On the same principle I am trying to assemble an automobile for a poor woman who has none."—*Louisville Courier-Journal.*

Mr. Benham—Why did that woman keep you standing at the door for half an hour?

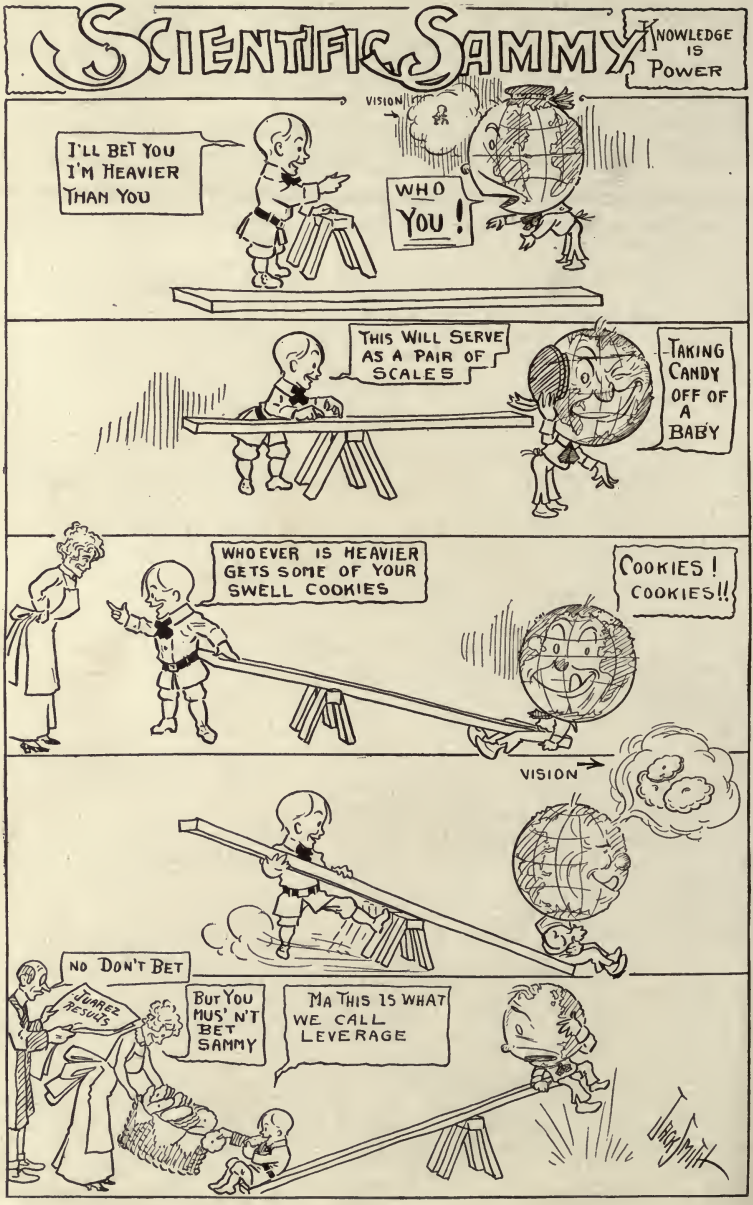
His Talkative Wife—She said she hadn't time to come in.—*Pearson's Weekly.*

"How did that blackhander come to be taken redhanded."

"Because he was a green hand."—*Chicago Post.*

Teacher—Tommy, where is Mexico?

Tommy—On page 10 of the jography, miss.—*Red Hen.*


SCIENTIFIC SAMMY
KNOWLEDGE IS POWER
I'LL BET YOU I'M HEAVIER THAN YOU
VISION
WHO YOU!
THIS WILL SERVE AS A PAIR OF SCALES
TAKING CANDY OFF OF A BABY
WHOEVER IS HEAVIER GETS SOME OF YOUR SWELL COOKIES
COOKIES! COOKIES!!
VISION
NO DON'T BET
JUAREZ RESULTS
BUT YOU MUS' N'T BET SAMMY
MA THIS IS WHAT WE CALL LEVERAGE
IRA SMITH

The WORLD'S ADVANCE

Vol. 30 JUNE, 1915 No. 6

A RELIC OF THE UNDER-SEA

MANY are the points of interest for the visitor to the New York Navy Yard, but perhaps none is of greater interest than that which greets the landsman as he enters the yard; resting grimly on the lawn is a curious object in sombre gray that represents one of the first attempts at submarine boat construction. A clumsy and ineffectual affair it appears to be, and when one learns its history, the appearance is found to have been borne out in practice.

A tablet attached to the submarine tells us that the *Intelligent Whale,* as she was called, was built in 1864 by C. S. Bushnell, Augustus Rice and Halstead of New Jersey. In marked contrast to the present day construction, the craft was built with an exceedingly wide beam; indeed, the diameter of the vessel is nearly one-third of its length

Photo. International News Service

The "Intelligent Whale," One of the Earlier American Submarines, Built in 1864, and Now Resting in the New York Navy Yard.

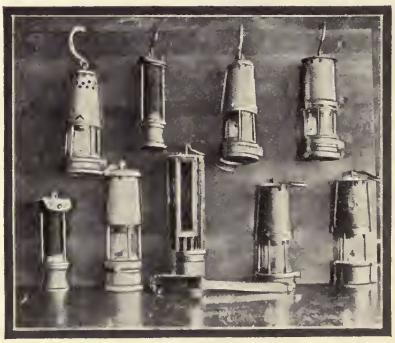
of about 28 feet. The crew numbered thirteen, and it is safe to assume that their efforts were confined chiefly to the matter of propulsion, which was effected by hand power applied to a screw propeller. It is said that a speed of four knots per hour was attained with the craft submerged.

Submergence was accomplished by means of water ballast, and diving through the agency of horizontal rudders placed at the stern. The inherent tendency of this type of boat to plunge straight for the bottom instead of to settle quietly on an even keel proved to be the undoing of the *Intelligent Whale*, for in 1872 she was tried and condemned after having carried her crew to the bed of the sea, where they paid for their bravery with their lives.

HOW SAFETY LAMPS ARE USED IN MINES

The principle of the safety mining lamp is based on the fact that a flame will not pass through a metal screen. The metal rapidly absorbs the heat and dissipates it into the air, so that it is impossible for a flame to pass from one side to the other. This fact was first discovered by Davy, an English scientist, and the principle of the Davy lamp has been embodied in all others ever since. In modern lamps, glass has been substituted in part for the screen, to provide better illumination.

The safety mining lamps are not only used for lighting purposes, but also have come to be of great value in testing the air of mines for the presence of explosive gases. The gas passes through the gauze and on coming into contact with the flame small amounts of it burn with a slightly different colored flame than that of the wick, forming what is known as the flame cap. A skilled observer is able to tell very accurately just what percentage of gas is present by the size of the flame cap.



A Collection of Safety Lamps Used in Coal Mines. Many of these Lamps Are Now Using Glass Instead of Wire Gauze.

THE ENERGY OF A MOVING AUTOMOBILE

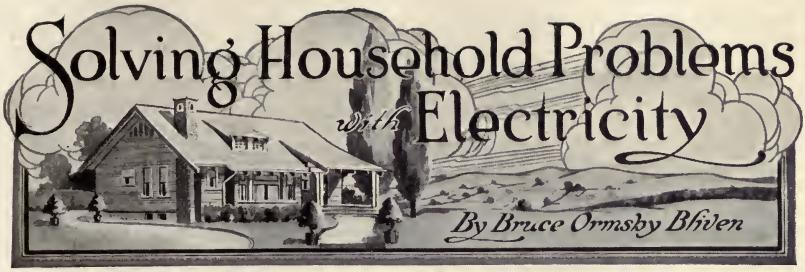
It was going 60 miles an hour!

That is a favorite expression used when describing the speed at which a train or an automobile travels past.

What if an automobile traveling at the rate of 60 miles an hour should come to a sudden stop, such as, for instance, by striking a heavy bridge abutment? A fair idea of the completeness of the wreck may be had by imagining the machine falling from a height of 120 feet, or from the top of a ten-story office building. An object falling from a height of 120 feet would have the same velocity at the instant of striking the ground as the automobile would have when traveling 60 miles an hour.

The energy possessed by a 2,400-pound automobile traveling at the rate of 60 miles an hour is 290,000 foot-pounds, which is the same as that of a body weighing 1,000 pounds at the instant of striking the ground from a drop of 290 feet.

Were a resistance of 6,600 pounds applied to the automobile, it would come to rest in a distance of 44 feet in one second of time, and in coming to rest would be doing work at an average rate of over 527 horsepower.



THE ideal home of the future will be one wherein human labor will be reduced to a minimum by the application of labor-saving machinery and methods. And beyond the question of a doubt the main agent in the realization of this ideal will be the electric current. Here is an instance of the profuse application of electricity that might well be followed with profit.

IN the heart of Southern California, a few miles from Los Angeles, a beautiful home lies among the foothills, snuggling up to the base of the mountains; a home which is said to be the most completely electrified home in the Southwest, if not in the entire country. Every function of the household which demands the application of continuous power is carried on by means of the omnipotent "juice"; and by ingenious adaptation of machinery several tasks are performed in this way which are ordinarily thought to be impossible of accomplishment except by manual labor. Moreover, the ultra-modern home in question is an object lesson in the possibilities of country life. The house is situated several miles from the nearest town—a condition which is ordinarily thought to be incompatible with comfort in living; and yet, at a cost which certainly cannot be called excessive, this home has been fitted with far more conveniences than any town house can boast.

The home in question is "Anoakia," the famous residence of Mrs. Anita M. Baldwin, whose father, famous the country over as "Lucky" Baldwin, when he died bequeathed to her the splendid Baldwin ranch. The house on the ranch is, however, new and was designed by Mrs. Baldwin herself. Comfort and convenience were the ideals strictly adhered to, although the home is esthetically beautiful and architecturally satisfying as well.

Power for all the various enterprises of the "Anoakia" ranch is secured from one of the big power companies, and no attempt is made to generate it on the ranch. One of the most important of the duties outside the house is performed by the electric pump, which pumps water for the irrigation of several thousand acres. There are a number of wells in various parts of the estate, and from these the water is pumped into a main reservoir with a capacity of over 4,000,000 gallons, from which the water is distributed as needed.

An interesting feature of the house itself is the big "Jinks room," especially dedicated to the good time spirit. The walls of this room are decorated with some charming paintings, electrically illuminated by indirect lighting. Through the swinging doors is to be found a tiny

electric kitchen, completely equipped. The fumes and odors from the cooking are dispelled by an electrically-operated exhaust fan.

A novel electric device is the hair-drier, which provides a blast of air with which to dispel the dampness in Miladi's tresses. A one horsepower motor is attached to a small compressor, and one hour a day of operation provides an ample quantity of compressed air. Pipes from the compressor tank run to the several dressing rooms.

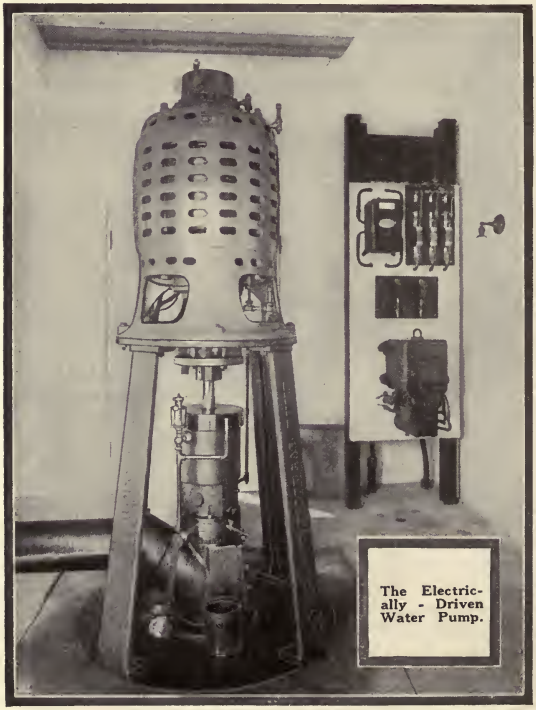
A refrigerating plant of six tons' capacity is located in the basement. A fifteen horsepower motor operates it, producing about 400 pounds of ice a day, providing refrigeration for several boxes containing approximately 1,500 cubic feet. While the machinery is running, a small pump, driven from the main shaft, circulates brine through the cooling pipes in the boxes. Two or three hours of operation each day will maintain a temperature in the boxes just below freezing point.

A separate circulating system provides cold water for drinking purposes in nearly every room in the house. A tank has been provided through which passes a set of brine coils for cooling the water. The pump is operated by a small electric motor.

As might be expected, the problem of keeping the house clean is also solved by resource to electricity. An electric vacuum cleaning machine is located in the basement, and operates in every room. There is no such thing as sweeping or dusting at "Anoakia" ranch.

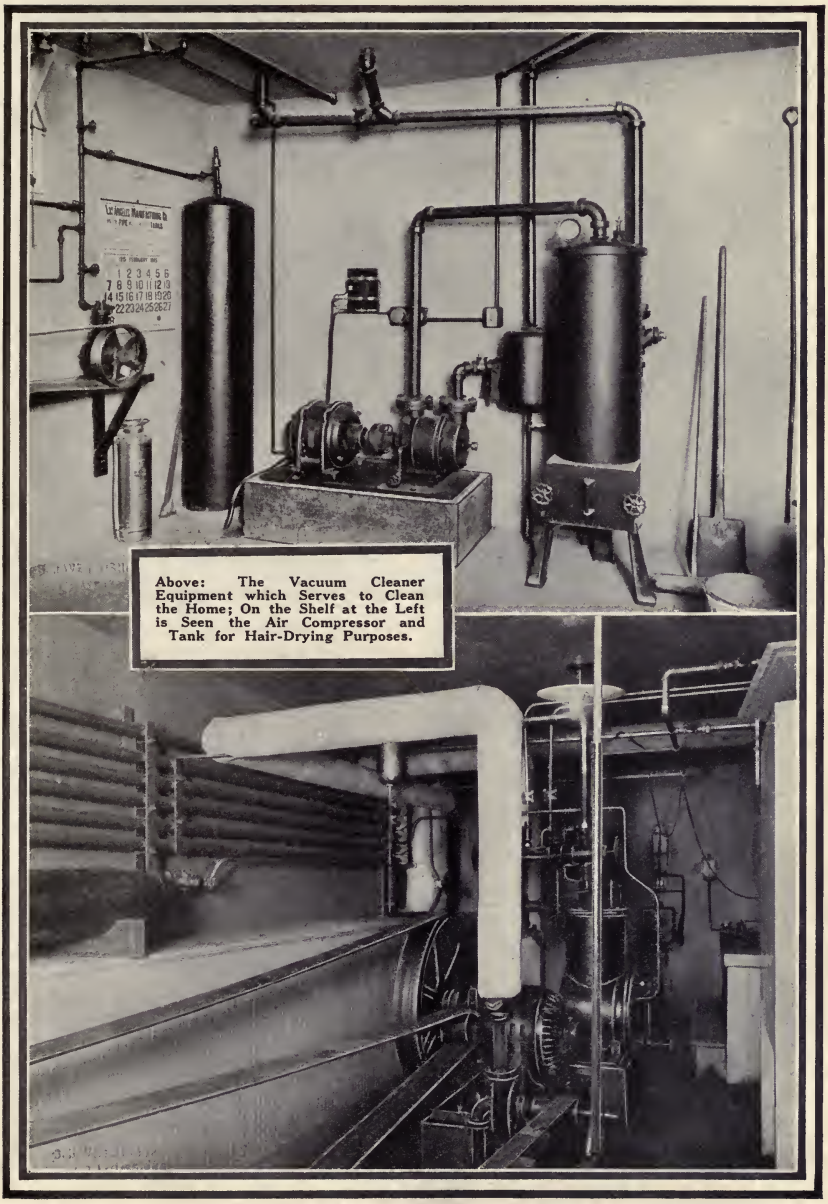
The laundry is in a building of its own near the residence. Here an electric washing machine, an electrically-operated mangle, and several small electric irons are found.

A vacuum cleaner is also found in the garage, where it is used in the care of the several automobiles which are kept in constant service. In connection with the garage is a beautifully-equipped machine shop, prepared to do anything necessary in repairing the ranch machinery. In this machine shop all the motive power is, of course, electric. A lathe, drill press, grinder and several smaller pieces are all operated from a shaft attached to a five horsepower motor.



The Electrically - Driven Water Pump.

The water used in the household is procured from a well remote from the buildings. Near this well is a large cement reservoir built on top of the ground. A compartment in the same structure contains a pressure pump, a filter and an iron tank with a capacity of 1,800 gallons. The pressure pump sends the water into the tank, whence it is distributed under fifty-



Above: The Vacuum Cleaner Equipment which Serves to Clean the Home; On the Shelf at the Left is Seen the Air Compressor and Tank for Hair-Drying Purposes.

A View of the Laundry Where the Electric Current Replaces Manual Labor.

pounds pressure to all the buildings. Water for all other purposes on the estate is lifted from the well into the reservoir by a direct-connected forty horsepower motor operating a centrifugal pump. From the reservoir it flows by gravity to all parts of the estate.

As might be expected in such an efficient home, the lighting system has not been neglected. The house is lighted throughout with the indirect lighting system, an interesting feature being the outdoor lighting on the broad verandas which surround the house. A large number of bronze metal lighting standards are carried around the edges of the porches, each containing a single frosted globe. When all of these are lighted, the effect, especially from a little distance, is extremely striking and well deserves that much overworked comparison to "fairyland."

THE JITNEY BUS IN NEW YORK

A new public vehicle has recently made its appearance on the streets of New York City. It is an electric storage battery bus, which greatly resembles the convertible street cars used in most American cities. It is known as the "jitney bus."

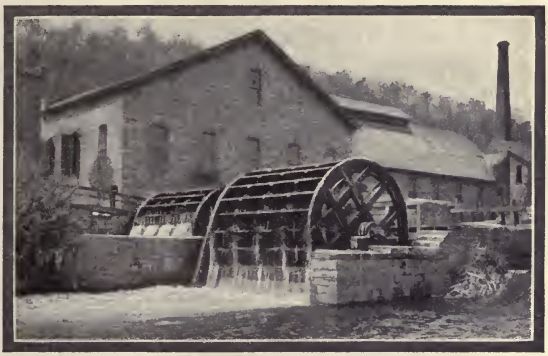
The electric bus is an innovation in motor bus transportation, and from the claims of low operating cost should prove wonderfully efficient for such service.

Buses of this type have a 2½ h. p., 60 volt, 32 ampere, 1,200 r.p.m. motor direct connected through a concentric reduction gear to each wheel, making all four wheels active drivers and allowing of an equal distribution of weight over all four wheels. This results in the elimination of slipping and skidding, affords maximum tractive effort, and tends towards a rolling motion when

starting rather than a lifting motion, as is the case with the two-wheel drive. Complete drive and unit may be removed in a few moments, so that in case of an accident either motor with its gearing can be quickly disconnected; the vehicle being capable of operating temporarily on the remaining two or three motors.

A 60-cell Edison storage battery supplies the motive power, giving a radius of 50 miles on a single charge, and, by the method of boosting permitted under the guarantee of this battery at a rate much higher than normal for a short period, over 100 miles actual operation has been obtained in 18 hours, including eight stops to the mile under a service test, in addition to stops caused by street traffic and the time required for boosting.

The body design of these buses follows more nearly that of street car practice, the prepayment system being used, with entrance at the rear and exit at the front. The buses have a seating capacity of 36 passengers, with cross seats and center aisle. They are semi-convertible; *i. e.*, the panels and glass are replaced by screens in the summer.



An Ingenious Water Wheel Arrangement in Which the Power is Applied to Another Wheel in Order to Raise Water to a Higher Level.

RAISING WATER BY NOVEL METHOD

The water wheels shown in the accompanying illustration were constructed in order to raise the water from the river into an adjoining canal. This was necessary because of the fact that the water in the dam is quite often a foot or two below the level of the canal. The larger wheel is the open wheel and it serves to drive the smaller one. The latter is a wooden box wheel that lifts the water into a little channel built to conduct it under the hill, shown in the picture, into the canal. These wheels are made entirely from wood, the larger one being 15 feet in diameter and the smaller one 10 feet.

One of New York's Jitney Buses, which Are Destined to Relieve the Present Congestion of the Metropolis's Street, Elevated and Subway Lines.

ELECTRICITY AND THE "MOTOR POINTS" OF THE BODY

A curious application of the electric current is that made by experimenters in medical science in producing certain desired facial expressions. These are, it is stated, obtained by applying one pole of the circuit to the "motor point" necessary and the other pole to an indifferent portion of the body of the subject. This part is generally the breastbone. It appears that these motor points are the only ones at which the electric current produces the desired effects. In this relation it should be added that it is at these points that the nerves controlling certain muscles enter those muscles.

If it be the object of the experimenter to produce upon the subject's face an expression of deep dejection, all he has to do is to place the two poles at the sides of the chin—one at each side. The current causes a contraction of the muscles controlling the upper lip. This lip is drawn downward and outward, thus producing immediately the desired effect.

If the experimenter wishes to get an expression of great mirth on the part of the subject, the electrodes are placed one in front of the lobe of each ear on the cheek. The effect of the bilateral contraction is to draw the angles of the mouth outward, to throw the skin of the cheeks into arc-like folds, and to close the eyes. An expression of sardonic mirth may be brought to a point of horror, thus giving to the face of the subject an expression of great repulsiveness.

An expression of conceit and haughtiness may be obtained by the contraction of the "elevator" of the lower lip and chin, the effect being to flatten the chin and to produce a slight rise in the under lip.

What is stated above with reference to the facial muscles applies also to the other muscles of the body. The electric current can produce any effect practised by Nature. Each separate finger or toe can be wriggled, the leg can be drawn or kicked out with force, the arm can be made to perform various motions, the ears even can be made to move, the skin to tremble, or the teeth to chatter. In brief, electric current can produce any expression of the human face, from extreme pleasure to extreme pain; from the direst anger to the most exalted repose. The mouth can be made to assume a "pucker" for kissing; and the tongue may be made to "loll out," or to move back and forth outside the mouth.

A HANDY DEVICE FOR THE FISHERMAN

A native of Virginia has recently invented a convenient contrivance that may be employed to good advantage by the fisherman who uses a rod. It is a metal stamping of a peculiar form which adapts

Applicable to a Wide Variety of Different Purposes, this Recently Invented Device is a Boon to the Fisherman.

The Handy Fisherman's Device in a Number of Different Applications: In One View it is Shown in Use as a Holder for a Fishing Rod; it is Fastened to the Side of a Row Boat and Leaves the Fisherman's Hands Free for Other Tasks. In Another it is Depicted as a Worm Digger, while in Still Another it is Used to Hold a Rod to the Belt of the Fisherman.

it to a plurality of purposes. For instance, the device may be used to dig up worms, when utilizing its sharp end. Then again, it can be employed as an implement for cutting and cleaning the fish. But the most important function of the invention is to hold a fishing rod in a number of different positions and to signal by means of a small bell when a fish is on the line. As shown in the accompanying illustrations, the fishing rod may be held over the side of a rowboat or even in the fisherman's belt so as to allow his hands full freedom. A number of holes into which fits a split pin permits the adjustment of the device to hold any sized rod in any position desired.

ELECTRIC SCALES FOR RAPID WEIGHING

Electrically-operated scales which automatically control the amount of goods entering a container are in use in wholesale establishments where packages of standard weight are made up, as well as in retail stores putting out large quantities of sugar, coffee, rice and other staples in paper bags.

In the accompanying illustration is shown a typical electrically-operated scale. The large, funnel-shaped container above the scale serves to hold a full sack of sugar, a drum of coffee or other goods in bulk. It can be lowered

Much Time and Labor is Saved by the Use of the Electric Weigher, Which Automatically Weighs Out Goods in Bulk.

to the floor to receive its contents and then raised to a position above the weighing table. The lower end of the funnel is supplied with a little metal disc about the size of a dollar, which slips into place to check the flow when the proper amount has been delivered. This action is accomplished by an electrical device; the current being furnished by a set of dry cells. The current is switched on and off at the proper moment by means of a contact formed by the needle of the scale dial. Suppose the package is to contain twenty pounds; the face of the dial is provided with a small indicator at the circumference, which is set at the twenty-pound mark, and the needle, coming in contact with it as the package reaches that weight, forms an electrical circuit and instantly checks the delivery. Even the weight of a paper bag can be allowed for, so accurate is this time-saving device.

NITROGEN LAMPS IN ARC FIXTURES

When the New York City arc lighting system was abandoned and the new nitrogen filled tungsten lamps were installed, instead of following the usual expensive practice of dismantling the old posts and fixtures, only a slight change was made. The arc mechanism was removed from the casing and large sockets installed so that the tungsten lamps could be inserted. These fixtures are in process of installation throughout New York, an interesting feature being that in substituting the new lamps for the old the service does not suffer interruption.

DREDGING MACHINE LOADS TRUCKS ELECTRICALLY

The speed with which motor trucks can be handled and the high cost of their maintenance has resulted in the invention of an electric loading machine which, so it is claimed, will do the work of a dozen men. The new electric loader can dig easily into piles of large cobblestones, as well as various grades of earth and sand. No skill is required in its operation. The truck is driven under a chute, the buckets or clams of the digging mechanism are adjusted, and the current is turned on. Broken stone, sand and

This Electrically-Driven Machine Takes the Place of Several Laborers in the Loading of Broken Stone, Sand, Gravel and Other Similar Material.

gravel are loaded at the rate of one cubic yard per minute at a cost of less than one cent per cubic yard for electric current.

The manufacturers claim that contractors have increased their output of broken stone 200 to 300 per cent. with the electric loader. It is built entirely of steel so as to withstand hard service.

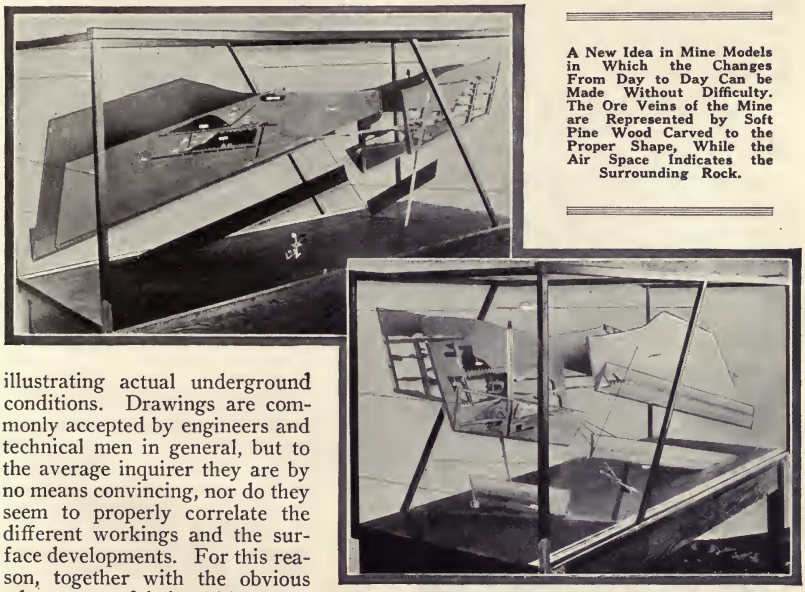
IMPROVING SAYVILLE WIRELESS STATION

The transatlantic wireless station at Sayville, L. I., which has been serving as a direct means of communication between Germany and the United States during the present war, is now being improved to make it more effective.

A NEW IDEA IN MINE MODELS

The difficulty of getting a clear conception of the interior workings of a mine has led to a great many methods of illustrating actual underground conditions. Drawings are commonly accepted by engineers and technical men in general, but to the average inquirer they are by no means convincing, nor do they seem to properly correlate the different workings and the surface developments. For this reason, together with the obvious advantages of being able to see at a glance the condition of the various ore bodies, actual models have been constructed that show on a small scale the interior of mines and the daily progress made in their working.

Mine models are often made of glass or celluloid, so that, being transparent, a view of all parts can be secured at the same time. The workings in ore and in barren rock are painted in different colors on the transparent material. These models are rather inflexible, though, so that the latest development, which overcomes its defects, is a model in which the surrounding rock is represented by space and the ore veins are pieces of soft pine wood carved into the required shape. These pieces are suspended in place in a glass frame. The various workings are outlined upon the wood and then cut out with a jig saw, the vacant spaces representing the places from which the ore has been mined. The remaining portion is painted as nearly as possible to the ore color. Where the ore bodies intersect the surface, they are cut to agree with the actual land contour.



A New Idea in Mine Models in Which the Changes From Day to Day Can be Made Without Difficulty. The Ore Veins of the Mine are Represented by Soft Pine Wood Carved to the Proper Shape, While the Air Space Indicates the Surrounding Rock.

Since only the ore is represented, the intervening rock being left to the imagination, the work of keeping up the model is facilitated, and an illustration is obtained which enables any one to get immediately a perfectly clear idea of the value and extent of work in the mine.

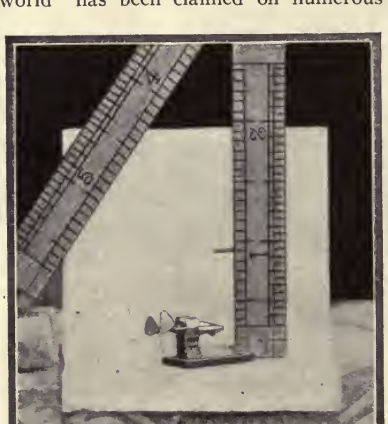
RIFFELHORN LIGHTNING-TUBES

At a meeting of the Geological Society in London there were recently exhibited some specimens of "lightning tubes," found on the summit of the Riffelhorn, a sharp, rocky point near the celebrated Matterhorn in Switzerland.

These tubes were about one-tenth of an inch in diameter, and lined with a thin film of glass, black or dark brown in color, and formed by the melting of some of the constituents of the rock as the lightning penetrated it.

ANOTHER "SMALLEST MOTOR"

An electric motor only 5/16 inch in height and 3/8 inch in length, in the construction of which no lathe or machinery was used, is shown in the accompanying illustration. "The smallest motor in the world" has been claimed on numerous occasions before, but this tiny motor has undoubtedly better claims than any of those which have gone before. It is only half the height of a five-cent piece and is self-starting, running at high speed on 1½ volts. Some of the parts are almost microscopic. The diameter of the shaft is 1/32 inch, the diameter of the commutator ⅛ inch and its length, 1/16 inch. The length of the brushes is ¼ inch and the thickness 1/1000 inch. The armature is of the three-pole type, with eighteen turns of wire on each pole.



Here is the Latest Claimant to the Title, "The Smallest Electric Motor in the World." Any Challenges?

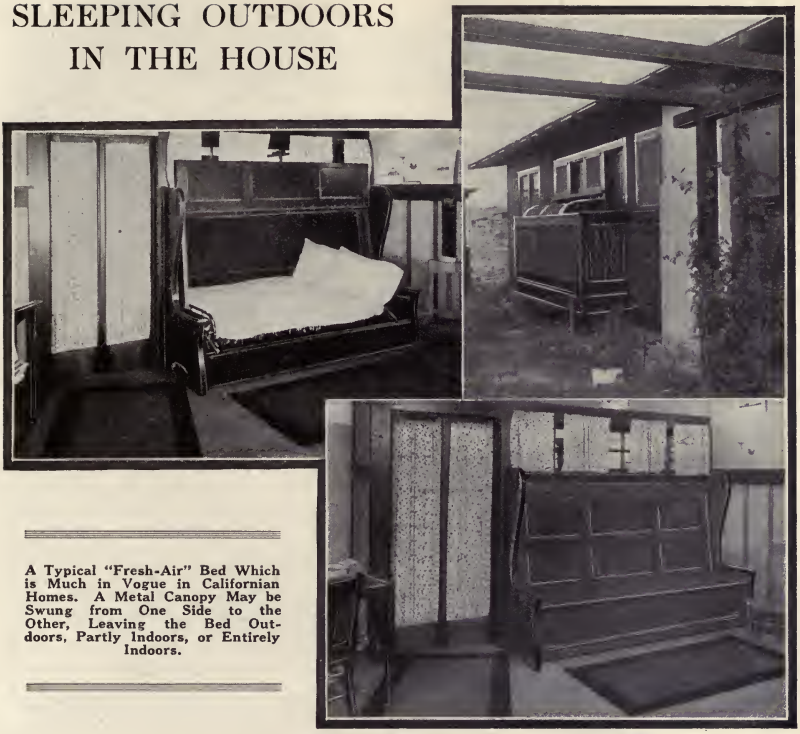
GERMAN DISINFECTION OF CARS

A German engineer has solved the difficult problem of sterilizing a railway car quickly, thoroughly and inexpensively, without taking out fittings and hangings. It is easily understood that cars may readily be carriers of disease germs and of more repulsive, if less dangerous, vermin. The German coaches returned from Russia are often in filthy condition. By the German plan each is run into a specially constructed steel cylinder, at the Potsdam shops, sealed in and heated by steam coils to 140 degrees Fahrenheit. Air is then pumped out until such a vacuum is formed within the cylinder that water will boil in it at that temperature. Thus all moisture is evaporated from the car without injury from great heat. For special purposes of disinfection the cylinder is then filled with formaldehyde gas, which kills all insects and germ life in the car. In twenty-four hours the car is again ready for service.

THE DECAY OF GLASS

It is probable that but few persons who admire the iridescence of ancient glassware know that the prismatic hues displayed are a result of the decay of the glass. When disintegration sets in, the substance of the glass splits into exceedingly thin laminae, which, as the sunlight traverses them, give rise to a splendid play of colors. As in the instance of the leaves of a forest, these delicate glasses signalize their approaching dissolution by becoming more beautiful.

SLEEPING OUTDOORS IN THE HOUSE



A Typical "Fresh-Air" Bed Which is Much in Vogue in Californian Homes. A Metal Canopy May be Swung from One Side to the Other, Leaving the Bed Outdoors, Partly Indoors, or Entirely Indoors.

What is known as a fresh-air bed has been designed by a Californian and used with success in Los Angeles residences and apartment houses. The fresh-air bed is built between a tiny balcony—too small to be called a sleeping porch—and the interior wall of the room. Its most interesting feature is a canopy which swings from a position outside the bedroom and leaves the couch outdoors. This canopy, or dome, is of metal, covered with wood veneer. It swings over the bed and may be left with an opening to the interior of the room and to the outside air, thus leaving the occupant of the couch in a through draught. Or it may be swung clear back into the room, shutting out the bed and leaving it in the open air. The sleeper outdoors is protected from insects by a screen, and from prying eyes by a window curtain which may be drawn at daybreak. The advantage of this form of bed is that it requires so little space to get the results of a sleeping porch. The balcony is only two feet or so outside the exterior wall. The bed is concealed from the interior of the room by day, as it is readily converted into a broad divan as shown in one of the accompanying illustrations. Unlike most built-in beds, this one can be made up and receive an airing from the balcony all day. Another interesting feature is a reading lamp as a fixture, similar to the lights used in sleeping car berths.

If you enjoy THE WORLD'S ADVANCE, tell others; if not, tell us. Why not lend this copy to a friend when you have read it through?

CONCRETE FENCE-POSTS

Several English railways, notably the London and Northwestern, have recently constructed fence post of reinforced concrete, and the results are reported to be very satisfactory. It is estimated that the life of such posts may extend to one hundred years, while that of creosoted deal posts does not exceed twenty years.

The concrete posts cost about forty cents per yard, and it is said that in many places cement, sand and iron can be obtained and made into posts at a less price than deal timber. The same material has been tried for "railway sleepers" with good results. Steel sleepers were first tried, but were found to be too noisy.

WHEN RUSSIA OWNED ALASKA

In the accompanying view is seen one of the old Russian forts built on the island of St. Michael in the Bering Sea, at a point not much over sixty miles from the shores of Siberia. Needless to say, this fort is of no value to-day, although in its day it was effective.

A Russian Fort Built on the Island of St. Michael, Alaska, Many Years Ago.

REMEASURING THE STANDARD YARD

Recently an exquisitely careful remeasurement of a treasured standard yard in the possession of the Royal Astronomical Society of Great Britain was made by the Deputy Warden of the Standards.

This standard, which consists of a brass tube 63 inches long on which the yard is laid down, the divisions being cut in palladium pins inserted in the brass, was measured with extreme care and accuracy by Francis Bailey in 1834 and again in 1851. Astronomer Airy then showed that there had been a measurable increase of length. The last measurement shows that the standard has further lengthened to the amount of .00063 of an inch since 1851. It is suspected that this increase is due to molecular changes in the metal. Curiously enough, the relative length of the subdivisions remains unchanged. The fact that changes to be measured only in hundred-thousandths of an inch should lead to a long and earnest discussion is calculated to increase confidence in the accuracy of scientific proceedings.

IONO-MAGNETIC ROTATION

This is the term given by Professor Righi to a certain phenomenon.

If a spark from a condenser of considerable capacity is sent horizontally through a gas, and two small vertical planes of mica in the form of a cross are suspended in the middle of the discharge by a fine fibre attached to the center of the cross, the spark produces no rotation of the cross. If, however, a vertical magnetic field is established in the gas, the cross rotates through a considerable angle if the gas is air, and over a small angle in other gases.

Doctor Righi ascribes this rotation to the bending of the paths of the ions or electrons and to the additional protection which the vanes afford each other against impacts from one side rather than from the other in these circumstances. The observed rotations indicate that the effects of the positive ions are in general greater than those of the negative.

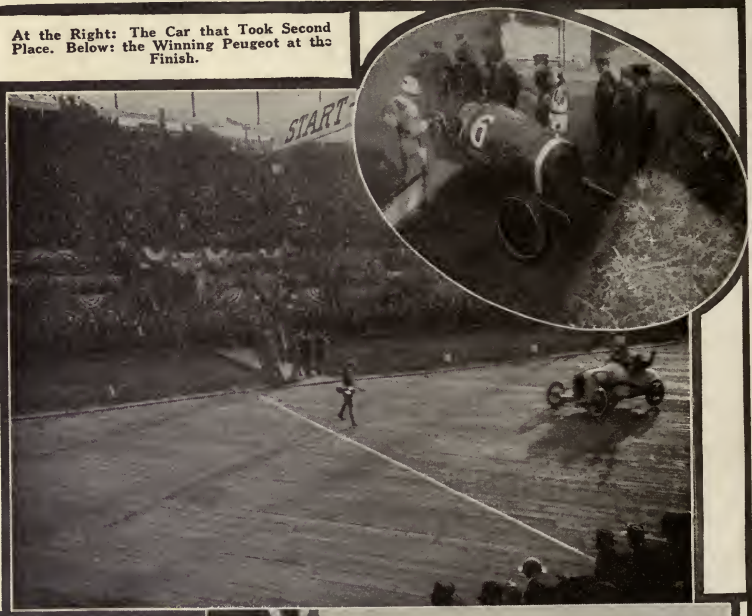
GERMAN SUBMARINE AND ITS TENDER

FOR many weeks the world has followed with mingled interest and awe the German submarine blockade of the British Isles. Rumors have occasionally gained circulation that the German raiders are replenishing their oil and other supplies by means of tenders, and at last this is proven by the view presented above. A. E. Wallace, staff photographer of the International News Service, after having spent several weeks with the German army in the East in taking both still and motion pictures, was ordered to England, from where he was to go to the front with the Allies in France. Mr. Wallace, in company with another American newspaper correspondent, A. F. Beach, sailed from Holland on the Dutch steamer, "Batavier V." Early one morning, while off the Belgian coast, Wallace and Beach were amazed on coming up on deck after breakfast to see a German submarine cutting across the stern of their boat at twenty knots per hour. It proved to be the "U-36," one of the latest German submarines.

Photo. Copyrighted International News Service

THE VANDERBILT CUP AUTO RACE

At the Right: The Car that Took Second Place. Below: the Winning Peugeot at the Finish.



Dario Resta, America's New Speed King, Covered the 296-mile Course in his Peugeot No. 9 in 4 Hours, 27 Minutes and 37 Seconds. His average Speed was 67½ Miles an Hour.

Three of the Contesting Cars Taking One of the Turns During This Race, Which Was Held on March 6th, at San Francisco, and Won by Dario Resta.

Photos Rockwell Feature Service

WITH THE FIGHTING MEN OF EUROPE

French Naval Reservists Chopping Beets for Military Horses.

Military mass for the German and Austrian Forces in Poland. All the Fighting Nations are Now Intensely Religious, and Services are Usually Held Before Going Into Battle. In this Instance the Mass Music is Furnished by the Military Band.

German 15-Centimeter Shells, Showing the Wicker Basket Protection

Above: Austrian Field Piece in Action During a Battle in Poland. At the Left: German Soldiers Near Gundsak, Poland, Receiving Their Pay. The Money for Paying the Soldiers is Sent to the Front in Chests, Carefully Guarded by a Strong Detachment of Cavalry, in Order to Defend it Against Possible Cossack Raids.

Photos. Copyrighted International News Service.

INTERESTING SIDELIGHTS OF THE GREAT WAR

A Bombproof Telephone Station for the Austrian Artillery in the Carpathian Mountains.

Above: German Soldiers of the Landstrum Companies, as a Rule, Cannot Write. The Few Men Among Them Who can Write are Kept Busy Writing Letters for Their Companions. Here is Seen One of These "Company Writers." Below: One of Germany's Latest and Largest Submarines, Photographed from the Dutch Steamer "Batavier V."

American Hospital and Attendants in Servia. The Worst Enemy that this Gallant Little Kingdom has to Fight at the Present Moment is the Dreaded Typhus Plague, Brought About by Lack of Medical Attendance in the Early Days of the War. There are Now Numerous American Medical Attendants and Hospitals Combatting the Plague and Caring for the Wounded.

Photos. Copyrighted International News Service.

WHERE SCIENCE AND INGENUITY ABOUND

A Pontoon Bridge Thrown Across the Irrigation Canal Near the Australian Camp at the Pyramids, in Egypt. It is the work of the 3rd Field Company of Engineers of the Australian Contingent.

An Example of the Ingenuity of French Soldiers. The Cylindrical Frames Made of Wooden Sticks and Twisted Twigs are Filled with Earth and Used to Cover the Guns When They are not in Action.

British Soldiers in Egypt Using the Heliograph. This Method of Signalling is Largely Employed by the British, Owing to the Favorable Climatic Conditions of Egypt.

The Soldiers of All the Nations Engaged in the European War have Shown a Marked Degree of Ingenuity. They Have in Many Instances Erected Elaborate Shelters Under the Most Trying and Difficult Conditions. Here is a Typical Example: A Row of Shelters Built by the French Soldiers in the Vosges Mountains and Used for the Cavalry Horses.

Photos. Copyrighted International News Service.

HOW ENGLAND CARES FOR HER WOUNDED

Three British Tommies who have been Wounded on the Battlefields of France and Are Now Convalescing in England.

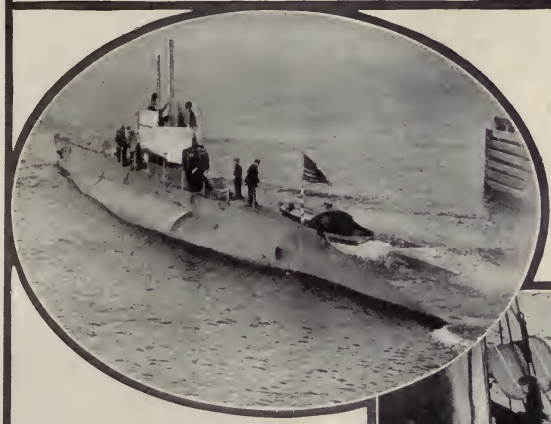
Above: Wounded British Soldiers Playing Football on the Great Lawn at Blenheim Palace.

Wounded and Maimed Soldiers are Quartered in the Blenheim Palace, Affording Them Every Possible Comfort Indoors, as Well as the Use of the Beautiful Surrounding Lawns and Walks.

The Convalescing Soldiers Spend Much of Their Time by the Banks of the River that Passes Through the Grounds.

Photos. Janet M. Cummings.

NEWS IN UNDER-WATER AND AERIAL NAVIGATION



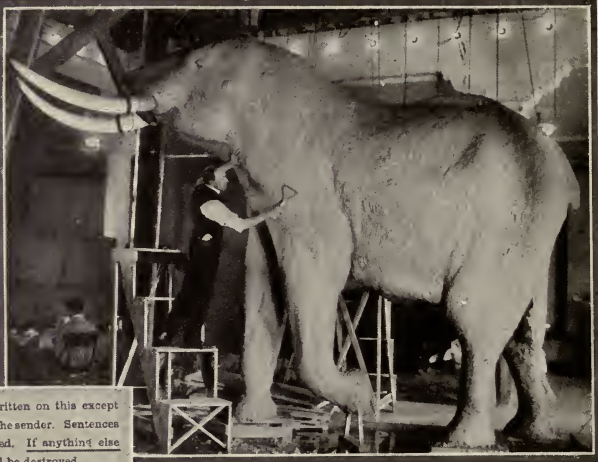
The New American Submarine, the "L-1," Leaving the Fore River Shipyards at Quincy, Mass., for a Trial Trip. This Underwater Craft is the Largest Yet Built by the United States Government, Being 170 Feet Long and Having a Displacement of 600 Tons.

In the View Below: The Wrecked Monoplane of Lincoln Beachy — the well-Known American Aviator Who Fell to His Death in San Francisco Bay Several Weeks Ago—Alongside an Army Transport After Being Dragged Up from the Bottom.

Another View of the Wrecked Monoplane. The Small Rowboat in the Foreground is Carrying the Body of Beachy, which was Brought Up by a Diver of the Battleship "Oregon."

Photos. Copyrighted International News Service.

ODDITIES FROM HERE AND THERE



Mounting the Largest Elephant Ever Brought Out of Africa, for Exhibition in the New African Hall of the Museum of Natural History, New York City. The Elephant—a Young Bull—Stands 12 Feet High at the Shoulders.

NOTHING is to be written on this except the date and signature of the sender. Sentences not required may be erased. If anything else is added the post card will be destroyed.

I am quite well.
I have been admitted into hospital { sick / wounded } and am going on well.
I am being sent down to the base.
I have received your { letter / telegram / parcel }
Letter follows at first opportunity.
I have received no letter from you { lately / for a long time }
Signature only.
Date

[Postage must be prepaid on any letter or postcard addressed to the sender of this card.]

In Order to Prevent Soldiers at the Front from Divulging Important Military Information When Writing to Relatives and Friends at Home, the British Authorities Provide Postal Cards with Printed Sentences. Soldiers are not Permitted to Write, but can State Their Physical Condition and Other Details by Crossing Out Everything but the Information that Must be Conveyed. The Postal Card Shown in the Accompanying Illustration was Received by an American Soldier from a Friend Serving in the British Cavalry now in France.

A Beach Rookery on One of the Pribilof Islands in the Bering Sea, Showing the Large Number of Seals that Come There to Breed. The Last Census of the Seals Indicated a Total of 268,305 Adult Animals and 92,269 Fur-Seal Pups.

Photos. Herbert Beardsley and Pacific Photo News Service.

THE CURIO SHOP OF THE WORLD

A Chinese School Located in the Chinatown Section of New York City. The Children of the Leading Chinese Residents are Sent to this School at 4 o'Clock in the Afternoon. The Earlier Part of the Day is Spent at Public School.

Above: A Compressed Air Locomotive Used for Hauling Ammunition at the Iona Island Arsenal. In the Oval: A Peculiar Burial Pole of the Alaskan Indians. A Chief's Wife is Enclosed in the Upper Cross-Piece, while the Chief's Body is Encased in the Upright Pole. At the Right: In the Center of the Group is the Egg of the Aepyornis—an Extinct Bird. The Other Eggs are Those of the Ostrich and the Hen.

Photos. Herbert Beardsley.

THE TRAINING OF BASEBALL PITCHERS AND THE TESTING OF AEROPLANES FOR MILITARY DUTY

The Target Used in the Coaching of the Pitchers of the Harvard Team.

Above: Arrangement Used by Coach Sexton of Harvard University in Training the Pitchers of His Team. The Testing Device is Placed Over the Home Plate. A "Groove" Ball Hits the Bull's Eye, while a Curved Ball Strikes the Sides.

A Burgess-Dunne Biplane Receiving Its Official Tryout at Marblehead, Mass., Under the Personal Supervision of Agents of the Russian Government. The Latter is in the Market for 200 American Aeroplanes Capable of Meeting the Conditions of the Test. The Machine Shown will Fly in Excess of 80 Miles per Hour and Climb 400 Feet a Minute with a Load of 700 pounds.

Photos. Copyrighted International News Service.

ELECTRIC ALARM SAFE.

The introduction of an electric alarm device in a small strongbox intended for the safe-keeping of jewelry and valuable papers offers an interesting problem in its design. Above all, the device must be simple in operation as well as positive; its setting and use must impose no annoyance or trouble upon the user; and to be a successful product in a commercial way the device must be low in cost or at least low enough to make the purchaser feel that the added cost is but a fair premium to pay for the insurance offered.

Interior and Exterior Views of the Alarm Safe, in which an Electric Bell is caused to Ring When the Safe is Moved in the Slightest Degree. In the Oval Below is Shown the Alarm Device which makes Contact through the Battery and Bell.

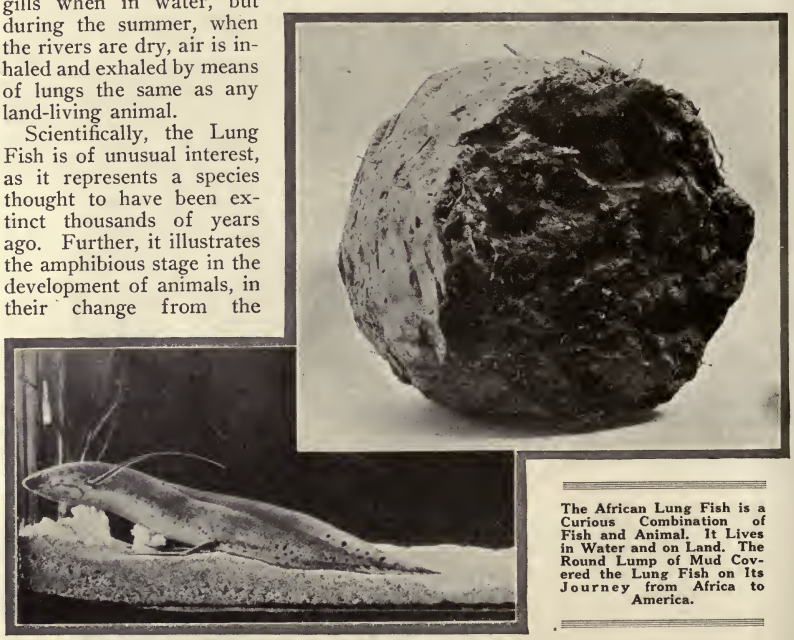
These requirements appear to have been met in every detail in a recently invented safe. The alarm device is the acme of simplicity and it resets itself automatically. A glance at the illustrations will serve to make clear the principle of operation. The reader will note that in the bottom of the safe are installed a battery, an electric bell, and the contact mechanism. The latter is of greatest interest, of course. Through the bottom of the safe is drilled a hole slightly smaller in diameter than the steel ball which may be noted in the enlarged view in the oval. Upon this ball is balanced a spring contact which is so nicely adjusted that the slightest movement of the ball causes it to slip off and complete the circuit through battery and bell. The latter will continue to ring until the safe is opened with a key held by the owner, and no effort expended upon the outside of the case will serve to stop the ringing. Immediately upon opening the safe the alarm is reset automatically through the agency of the small rod which may be seen projecting above the edge of the safe.

CURIOUS FISH WHICH INHABITS AFRICAN WATERS

A remarkable species of fish from eastern Africa was recently added to the collection of a New York aquarium. It is known as the African Lung Fish on account of its unusual ability to live out of water for several months at a time. The African Lung Fish makes its home in mud or clay and when it was transported to this country, instead of being placed in the customary tank of water, it was embedded in a large block of dry earth in which a hole was made so that the fish could breathe.

The Lung Fish breathes by means of gills when in water, but during the summer, when the rivers are dry, air is inhaled and exhaled by means of lungs the same as any land-living animal.

Scientifically, the Lung Fish is of unusual interest, as it represents a species thought to have been extinct thousands of years ago. Further, it illustrates the amphibious stage in the development of animals, in their change from the water to the land-living state.



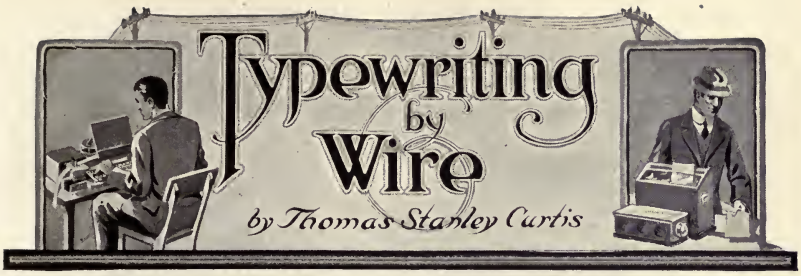
The African Lung Fish is a Curious Combination of Fish and Animal. It Lives in Water and on Land. The Round Lump of Mud Covered the Lung Fish on Its Journey from Africa to America.

In appearance, the Lung Fish resembles a salamander; it is long and eel-like, and its fins are used as legs in travelling over dry land. This is supposed to be the first living specimen of a Lung Fish to be brought to this country, and is therefore of great interest.

UNDERGROUND TEMPERATURES

It was formerly believed that the temperature increased at a fairly regular rate with descent into the crust of the earth, but the experiments of Professor T. L. Watson have shown that measurements in deep mines and borings do not bear out the assumption.

Some investigators are now disposed to think that, instead of regularly increasing, the temperature is not far from stationary below the superficial zone. In the Witwatersrand mines the average rate of increase, carried down to 8,000 feet, is only one degree, Fahrenheit, for each 250 feet of descent. The bottom temperature is 102.35 degrees. Measurements in other places have given various results. In the Kalgoorlie mines in Australia practically no variation of temperature is shown between depths of 1,400 and 2,300 feet. The result of recent figures shows that there is no general law governing the increase of rock temperature with depth.



A TELEGRAPH *which takes its message on a modified form of typewriter at the transmitting end and prints the same message in type at the receiving end of the line would seem to be the last word in telegraphic progress. The engineers who designed and developed the new printing telegraph have not been satisfied with this achievement, however. They have gone a step further and have produced a machine that will send eight separate messages over the same wire at the same time. Truly the device marks a new era in the field of telegraphy.*

PICTURE in your mind a girl seated at a contrivance resembling a typewriter and typing a message which is reproduced with infallible accuracy in clear, readable type on a message blank, ready for delivery, perhaps thousands of miles away from the transmitting point. Then think of four girls at each end of the line and all of them sending separate messages at the same time over a single line. With this mental picture comes slowly a realization of the profound importance of the wonderful collection of apparatus which makes possible this feat.

No really great invention or achievement is conceived and also brought to completion in a day or even many days. True, the basic idea may come in the flash of a second, but in the development of even the simplest of devices, months and frequently years are spent before the invention is brought to a state even approaching perfection. Furthermore, every epoch-making invention must have been developed as the direct result of a demand. In the present instance, the demand was created largely through the vast increase in the business done by one of the greatest telegraph organizations in the world. This steadily increasing volume of business necessitated an increase in the facilities for handling it and to broaden the facilities meant either of two things—additions to the line equipment, or an improvement in the efficiency of existing methods of using the lines then installed. Obviously, the latter option was preferable, and, believing it to be practicable, the officials of the telegraph company called upon one of the prominent electrical manufacturers for coöperation in designing an equipment that was not only to increase the number of messages per line at the same instant, but which would expedite the transmission and handling of the messages at both sending and receiving ends. The result of the team work of the engineers

of both companies is seen in the quadruple-duplex telegraph printing system.

The far-reaching effects of the system will be appreciated when it is realized that the message typed at the sending end is duplicated at the receiving end just as fast as the sending operator can operate the typewriter. The increase in speed over the old method of forming each letter in a word by a series of dots and dashes as in the Morse code can readily be understood. A graphic evidence of the practicability of the system is supplied in the trial installation of the apparatus between New York and Boston; on this line, the apparatus has been constantly in service day and night for a year and a half, and, during this time, the speed of transmission has frequently reached 360 words a minute.

A Multiplex Table Equipment of the Printing Telegraph. On the Left is Shown the Printer with its Relay Box, the Transmitter and Automatic Control are in the Center, and on the Right is the Keyboard Perforator. Four of these Table Equipments would be Required at Each End of the Line in a Quadruple-Duplex Installation.

Operations Involved in Sending a Message

The principle of operation of the apparatus is clearly explained in the words of one of the engineers, as follows:

The transmission of messages by this system involves the following sequence of events: The operator prepares a tape by means of a key board perforator; the tape then passes through a transmitter which, working in conjunction with a distributor, sends certain electrical impulses over the line. These impulses operate a relay at the distant end which, working in conjunction with another distributor, passes the impulses on to a receiving printer, which translates them and prints the letters in the form of a message.

An analysis of these various steps will show that this new printing telegraph operates, to a certain extent, like a pianola. Just as the perforations in a pianola roll determine the particular notes to be played by the instrument, so the perforations in the telegraph tape determine the letters and characters to be printed by the receiving printer.

The Printing Telegraph Alphabet

In any printing telegraph system, the alphabet or code employed is of prime importance. Fundamentally, the code of the present system resembles the ordinary Morse telegraph code, in that it uses a series of electrical impulses which are variously combined to represent the letters of the alphabet. In the Morse code, however, the combinations are of unequal length. In the new printing telegraph code they are all the same length. Each letter or character signal is composed of five units, each unit being either a positive or negative electrical impulse. One of the accompanying illustrations shows the code. The heavy black lines *above* the dotted lines at the left represent *positive* current impulses; those *below* the dotted lines represent *negative* current. Each character, therefore, is represented by a combination of positive and negative current impulses. Thus the letter A in the printing code is composed of 2 positive and 3 negative units, *i. e.*, + + — — —. The letter D is also composed of 2 positive and 3 negative units, but the combination is different: + — — + —. The letter O, another combination of 2 positive and 3 negative units, is the exact opposite of letter A: — — — + +.

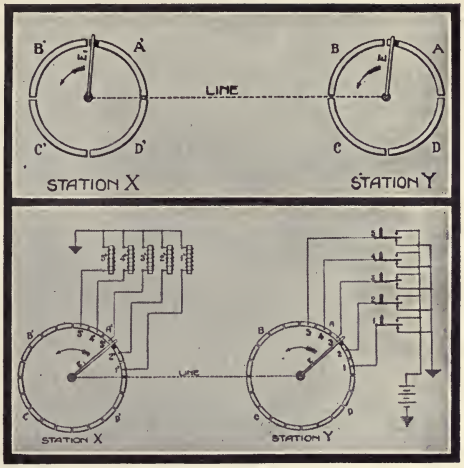
Coming now to the method of obtaining a number of transmissions over a single wire, it should be made clear, first, how four messages may be sent in one direction at one time. This constitutes what is known as quadruple operation.

Referring to the sketch of the quadruple principle, suppose that two metal rings (Station *X* and Station *Y*) are each divided into four equal parts, or quadrants. Contact brushes (*E* and E_1) rotate over the surface of the two rings, the brushes being connected to the opposite ends of a telegraph line, as indicated. If these brushes start from the same position, and rotate at exactly the same rate of speed, so that they remain constantly parallel, each quadrant of Station *Y* will be connected with its corresponding quadrant at Station *X* once for every revolution of the contact brushes, the duration of this connection being one-quarter of a revolution.

If, as shown in the other diagram, quadrant *A* be in turn divided into 5 segments, each segment representing one signalling unit, it will be possible to send 5 signalling units, or, in other words, one complete letter signal from *A* to *A'* for every revolution of the contact brushes.

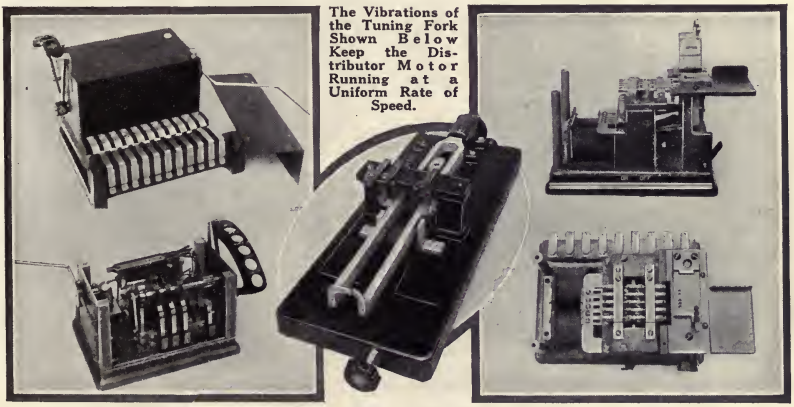
Each unit-segment of quadrant *A* is connected to a lever, as shown. This lever may engage either of two contact points; one point is grounded, while the other is connected to a source of electric current (a grounded battery in the illustration). Each corresponding unit-segment of quadrant *A'* is connected to ground through a relay.

Suppose now that, at Station *Y*, lever No. 3 of quadrant *A* be held against the contact that is connected to the battery. Then as contact-brush *E* passes over unit-segment 3, an electrical current will pass from the battery through lever 3, segment 3, and brush *E*, and over the line to brush E_1 at Station *X*. Since



Diagrams Showing the Principles of Quadruple Telegraphy and How it is Applied to the Printing Telegraph in Order that More Than One Message may be Sent over One Line at One Time.

The Vibrations of the Tuning Fork Shown Below Keep the Distributor Motor Running at a Uniform Rate of Speed.



At the Right: Interior Views of the Transmitter Mechanism, Showing the Contact Levers which Perform the Functions Described in Connection with Station Y in the Diagram Above. At the Left: Interior and Exterior Views of the Automatic Control which Stops the Transmitter in Case the Operator is Unable to Keep Up with the Pace Set by the Distributor.

brush E_1 is at exactly the same point of its revolution as brush E, the current will pass through unit-segment 3′ of quadrant A', and thence through relay 3′ to ground. Likewise, if any combination of the 5 levers connected to the segments of quadrant A be similarly operated, current will pass through corresponding relays connected to A'.

The function of the levers 1, 2, 3, 4 and 5 is performed by the transmitter of the system, the transmitter being controlled by the perforations in the tape. The corresponding relays, 1′, 2′, 3′, 4′ and 5′ are, in actual practice, a part of the receiving printer. The operation of a combination of these relays determines the letter to be printed. Thus the letter A will be printed by the operation of relays 1′ and 2′ together; the letter D by relays 1′ and 4′; and the letter O by relays 4′ and 5′.

The selection of the letter takes place while brush E_1 is passing over quadrant A'. A and A' being unconnected while the brush is passing over B', C' and D', the printer at A' has time to print the letter and move the paper forward for another signal, while the transmitter at A has time to "step" the tape ahead and determine the combination of levers for the next signal.

What has been said regarding quadrants A and A' applies to quadrants B and B', C and C', D and D'. Thus we see that with distributors as shown in Fig 3, it would be possible to send four messages simultaneously from Station Y to Station X. This constitutes quadruple operation. Now if the line is worked "duplex," it is possible to send four messages in the opposite direction at the same time. Space, however, will not permit a description of the details of duplex operation.

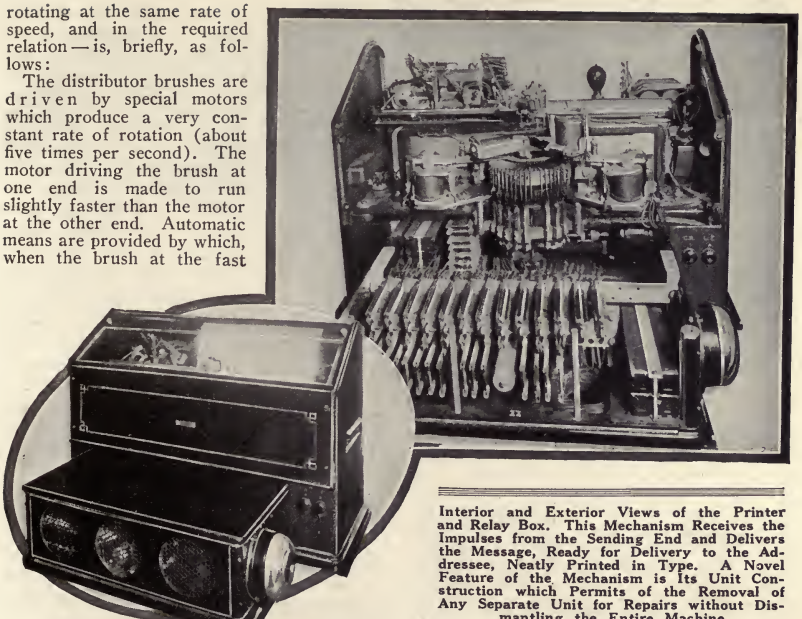
One further point needs explanation before leaving the last mentioned diagram. It is obvious that for the quadruple operation the contact-brushes at X and Y must rotate in exact unison. Otherwise, a signal impulse from lever 1, for example, might pass through relay 2′, causing a wrong letter to be printed.

The method of "synchronizing" the corresponding contact-brushes—*i. e.*, keeping them

Above, to the Left: The Distributor Motor and Its Mechanical Corrector which Automatically Steps Back the Brushes at the Fast End when They Have Gained a Small Angle on the Brushes at the Slow End. To the Right: The Distributor by Means of Which Four Messages may be Sent Simultaneously. Below, to the Left: The Keyboard Perforator which Prepares the Tape for the Transmitter which is Shown at the Right.

rotating at the same rate of speed, and in the required relation — is, briefly, as follows:

The distributor brushes are driven by special motors which produce a very constant rate of rotation (about five times per second). The motor driving the brush at one end is made to run slightly faster than the motor at the other end. Automatic means are provided by which, when the brush at the fast end gains a little on the brush at the slow end, a mechanism is operated which automatically sets or "steps" back the brush at the fast end. Thus, by intermittently stepping back the brush at the fast end when required, the brushes are maintained in proper relation.



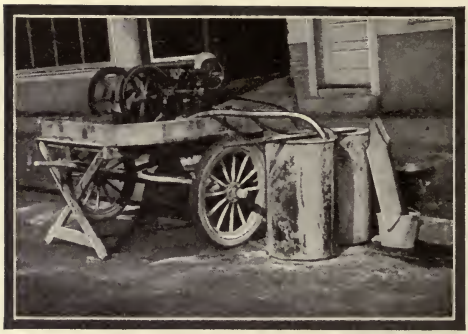
Interior and Exterior Views of the Printer and Relay Box. This Mechanism Receives the Impulses from the Sending End and Delivers the Message, Ready for Delivery to the Addressee, Neatly Printed in Type. A Novel Feature of the Mechanism is Its Unit Construction which Permits of the Removal of Any Separate Unit for Repairs without Dismantling the Entire Machine

It is difficult to imagine the possible limits in the field of usefulness of this system. While primarily designed for heavy commercial work over long distances, the small, independent user has not been forgotten. For use in factories, for transmitting material orders where absolute accuracy is essential, for hotels in paging guests, and for innumerable other purposes, an equipment known as a short line printer has been developed. While this apparatus does not combine the feature of several messages over one wire at the same time, still it offers every advantage in the way of telegraphic printing and amply serves the purpose for which it is intended.

In press work and the distribution of news matter, the system should prove invaluable. When the popularity of the present "ticker" system is taken into consideration, despite its limitations, the advantages offered by the printing telegraph, which prints the bulletins out in full just as fast as a typewriter can be operated, may well be realized. From a central distributing station, complete news bulletins could be sent in duplicate to any number of points at which the matter could be read without the annoyance attendant upon deciphering the puzzling codes now in use. Truly, the new system seems to be the last word in the transmission of written intelligence.

PAINTING WALLS BY MEANS OF TRANSPORTABLE PUMP

A small pump with a gas engine as motive power is trailed behind the little auto of a Los Angeles painter. It is mounted on a two-wheeled vehicle formed of parts of an outworn runabout and is readily taken to the job. When in use it is supported by a small trestle and the large cans containing paint are



This Home-Made Machine Constitutes a Very Complete and Useful Paint Sprayer. As the Illustration Shows, it is Quite Portable and, Although Crude in Construction, the Device is Capable of Heavy and Practical Service.

set alongside the trailer. A length of hose connects the pump with the liquid, which is conveyed to the wall that needs painting. The workman applies the color with a spray brush. For whitewashing and kalsomining this method is particularly effective. The method of painting by hose can be used on comparatively small jobs with economy by means of this pump-carrying trailer, which makes it easy to get the machine to the site of the work. Only a few dollars' worth of "junk" and a few hours' time went into the handy little vehicle.

HAMMER HANDLE WORN DOWN BY LONG SERVICE

Through constant use a shoe-maker's hammer, owned by a Western cobbler, has been worn until the grip of his hand is very evident on the handle, which at one place is worn to less than half an inch in thickness. The cobbler has used the hammer exclusively for thirty years, and in wearing down the hammer he has developed a very hard callous on the inside of his hand.

During the first ten years the cobbler owned the hammer he made more than 3,000 boots and shoes. When the large manufacturing plants began to take away this business most of his time was spent at repairing for the next twenty years. He repaired an average of forty-eight pairs of shoes a week. Using these facts as a basis for calculation, some of the work of the hammer is ascertained. It takes 140 nails to put half-soles and heels on a pair of shoes. During twenty years 52,000 pairs were repaired and it took 7,280,000 nails. The cobbler strikes an average of three blows to open a hole with the awl and drive the nail, so that 22,000,000 blows were struck with this hammer. There are 1,600 nails to a pound, therefore 3,640 pounds were used in the repair work, aside from the nails consumed in making boots and shoes.

ARTIFICIAL SILK MANTLES

Some time ago it was discovered that incandescent gas-mantles made of ramie fiber are much more efficient than those made of cotton. Ramie fiber possesses a wider mesh, and so affords a larger radiating surface. It has been found that woven artificial silk is rougher than ramie fabric, and consequently more luminous. Mantles made from continuous fibres of artificial silk are said to be elastic, supple and durable. The continuous fibers remain distinct and unbroken during use, whereas the short fibers in mantles made of cotton or ramie untwist more or less from the original structure of the spun yarn.

A Cobbler's Hammer That Has Been in Continuous Use for Thirty Years, and as a Result of Its Long Service the Handle has been Worn Nearly Through at the Point Gripped by the Cobbler's Hand.

The Filming of Animated Cartoons

MENTION the name "Colonel Heeza Liar" to almost any one and you'll see his or her face light up and a smile spread over it. Who doesn't know the funny little Colonel—who hasn't laughed at his antics as he hunted wild beasts in Central Africa, outwitted cannibals on the River of Doubt, cultivated his farm with the aid of some strange assistants and hunted ghosts in Castle Clare? The Colonel's friends are legion—probably no films made have as large a following among young and old alike as these, and speculation has been wide as to how these pictures are made—what gives the drawings those life-like motions and who is the genius who creates them.

One of the Popular "Colonel Heeza Liar" Animated Cartoons the Production of which Require a Vast Number of Pen and Ink Sketches.

J. R. Bray is the originator and creator of these drawings and he was the first to put motion into the drawing itself. That there is no royal road to success is again proven by the fact that Mr. Bray started his experiments over seven years ago, and that was when motion pictures were still very young. Years of careful, arduous work was necessary before the results satisfied him. Today he is the head of an organization devoted to making his pictures, has a corps of artists working under his supervision, and has patents on his process which cover the use of transparent material or material made transparent by any agency whatever in the making of animated drawings.

Mr. Bray was found in his sunny New York studio engaged in conducting

Heeza Liar through another series of escapades. Tall, slender and blonde, he looks more like a successful business man than an artist. Mr. Bray readily consented to talk about his work, which is now so well known to millions of movie fans the world over.

"The public," he said, "demands drawn illustrations which reveal the personality of the artist. The newspapers and magazines all prove that. It is easily seen that to illustrate fiction, for instance, a photograph rarely can be well used. The artist's drawing, on the other hand, can be idealized to fit the situation. This value of the illustration was recognized in everything but motion pictures, and now there, too, it has found its place. It is well to remember that an artist can draw that which is a physical impossibility for an actor to enact before a camera. The artist's possibilities are unlimited. The opportunity for real humor may be seen when one reflects that the humorous is almost invariably the unusual.

"Very few artists have the ability to make drawings that move. An extraordinary imagination is absolutely essential, as is also a perfect knowledge of the science of motion. Problems come to the artists in this work that never arise in ordinary art. I have employed some very able artists to assist me, and find that very few of them can get the knack. For instance, one of the hardest things in the world to handle in these animated drawings is perspective. To have a figure come from the far horizon straight toward the observer—to have it grow from a dot to the proper size and preserve the 'balance'—makes an almost insurmountable problem. I think I am correct in saying that not one artist in a thousand can put motion into drawings."

J. R. Bray, Originator and Creator of the Pathé Animated Cartoons, Began his Work Over Seven Years Ago and has been Perfecting His Productions Ever Since.

Few people would have the patience to do Mr. Bray's work. It takes between four and five thousand drawings to make 1,000 feet or one reel of film. In addition to the colossal toil of the art work it takes a week to photograph the drawings one at a time. Great speed united with unvarying accuracy is essential. Every stroke of the pen must count. Mr. Bray works so fast that he is able to keep four trained artists "inking in" the outline drawings which he makes. The necessity for accuracy is evident when it is learned that the drawings are magnified on the screen at least twenty-five times.

Mr. Bray spent years in study before he attempted to make an animated cartoon film. For months he haunted the Bronx Zoo in order to study the animals there and analyze their motions. He even bought a large farm across the Hudson from Poughkeepsie and stocked it with various animals in order to further extend his knowledge of animal anatomy. The result of these studies finds expression in the life-like motions of the various animals which move across his films.

He was born in Detroit, Mich., and has lived in New York since 1901. He was for seven years a newspaper artist, being also a steady contributor to the humorous weeklies, such as *Life, Puck* and *Judge*. He took his ideas to Pathé Frères over three years ago, since he felt that such a house with its many foreign branches could give him a larger international circulation than any other. The Pathé officials at once saw the value of his work and from that day to this he has dealt only with Pathé. Millions of persons have laughed and are laughing at the "Heeza Liar" and "Police Dog" series, and his political cartoons in the Pathé News, the motion picture weekly, have attracted widespread newspaper comment. Mr. Bray has truly originated a new school of art, and has given to the motion picture followers a distinct type of comedy that stands alone in the field.

Director and Camera Man Engaged in Producing a Scene of a Master Picture.

PRODUCING THE MASTER PICTURES

In the accompanying illustration is seen W. Christy Cabanne directing some street scenes in "The Lost House," a new Mutual five-part master picture by Richard Harding Davis.

The Mutual forces have recently announced their intention to produce multi-reel subjects of high quality. The film stories will be prepared by well-known writers and every effort will be made in producing the pictures to keep the standard high.

FILMS OF BIG SIEGE

When it was learned that Przemsyl was destined to become famous in spite of its name, the Pathé News sent its special war correspondent in Russia, Mr. Ercole, straight to the Galician front to the Russian army besieging the city. He was sent there to get pictures, and he did so. While he was turning his camera he was hit by a piece of shrapnel and painfully wounded, but he did not cease to turn and in consequence he has been decorated by the imperial government of Russia with the Cross of the Order of St. George.

His films were rushed by way of the Pathé agencies in Moscow, Stockholm and London to the United States, so on the very day the newsboys were using their fifty-seven different ways of pro-

nouncing Przemsyl to tell the public that the Austrian fortress had fallen, in the Pathé News projecting rooms at Jersey City the editorial staff of the News was looking at some very fine pictures of the siege.

THESE CITIES WANT THE MOVIES

Motion picture producing is proving such a remarkable advertising medium that practically every city, town and hamlet in southern California, as well as many in other sections of the State, has put in a bid for companies to film scenarios in its locality.

Thomas H. Ince, the well-known producer, is in receipt of several letters daily from secretaries of chambers of commerce and other public bodies, dwelling on the beauties of their respective communities and adding that their respective localities were ideally gifted for motion picture purposes. In some cases a community has offered to pay the entire expense of bringing out a company and installing the players in the best hotel free of charge.

A WELL-KNOWN CAMERA MAN AND HIS WORK

G. W. Bitzer, the best known of motion picture camera men, is D. W. Griffith's chief of staff at the Reliance and Majestic studios at Hollywood, Cal.

Bitzer has been acknowledged by film experts to be a master hand at the camera.

As chief photographer Bitzer supervises the work of the fourteen Reliance, Majestic and Komic camera men, and his suggestions to them are visible in their work.

It was about six years ago that Bitzer was assigned to turn the crank for D. W. Griffith. At a little later date Griffith reported that in his new camera man he had made a "find."

Some of the features he has photographed are "The Battle of the Sexes," "Home, Sweet Home," "The Escape" and the Griffith masterpiece now the subject of comment in film circles, "The Birth of a Nation." He was born in Boston, Mass.

EDITING OF MOTION PICTURE FILM

It is not generally known to the layman that in the producing of motion pictures it is necessary to photograph many hundreds of feet of action in excess of the finished subject in order to secure the most successful results. For instance, it is said that the total amount of negative film taken and developed for each two-reel Biograph photoplay is sufficient to make a three or four-reel picture. The film is gone over carefully in order to cut out sections that have a tendency to drag or that are not essential to the story of the photoplay. Scenes are shortened wherever possible until every foot of the 2,000 feet is full of action.

COMMUNITY CENSORSHIP FOR MOTION PICTURES

In lieu of any state or national censorship for moving picture films which they thought adequate to protect the morals of their community, several women of West Medford, Mass., have obtained permission of their Mayor to act as a committee to pass on all moving picture films shown in their district. As a result of their activities the film producers are sending only the highest grade films into their community and the tone of theatres in that vicinity has been raised to a most conservative level. Their Community Board is the first of its kind to receive official power to pass on pictures before they were shown.

RAPIER TIP SAVES EYESIGHT

Only the little metal protective tip on the top of a rapier saved William Bertram, of the American-Mutual studios, from losing the sight of his left eye. As it was, the sword top lacerated the eyeball and it was necessary for a physician to take several stitches in the wound.

THE dare-devils of the movies—the men who daily risk their lives to film the stories of news events—are the aftermath, the outgrowth of that intrepid band of young Americans who regenerated the moving picture industry some years ago, and who are responsible for the very existence of that industry today. No feat is too difficult or dangerous for them to attempt, if a lively subject is the incentive. They are the bulwark of the spirit that is keeping the movies alive today.

THERE is only one reason why the movies are alive to-day. That is, because several years ago, when the American public suddenly grew bored with the insipidness of photo-plays as a whole, a regenerating force in the shape of vital new blood was injected into the anæmic system. Intrepid young Americans with brand new ideas came to the front and insisted that these ideas be given at least a trial. The old régime shook its head with a doubt born of ancient stubbornness—and in so doing the old régime quietly passed.

Then the bored public suddenly became aware that something galvanic was happening. It took a second look at the hackneyed screen—and it has been looking with steadily increasing interest ever since.

The fact that "Standing Room Only" signs aren't hung out in front of the majority of moving picture theatres nowadays is simply because the signs are worn threadbare.

The keenness and the forcefulness of the Young American Business Man is proverbial. He is the rejuvenating force that has made this country the success that it is. Certainly, he has dragged the moving picture industry to the comfortable niche on the pinnacle it now occupies.

The same forcefulness, the same boldness and recklessness, characterizes the methods that qualify the movies for their immense popularity to-day. I do not refer to the creditable people who are concerning themselves with the dramatic uplift of the movies—theirs is another sphere entirely—but to those who risk life and limb every day in the week in putting news facts into filmed stories.

Down by the water front in an out-of-the-way tenement and factory district of New York is located the office and the

studio of the "Imp" and the "Animated Weekly." No more appropriate name than the latter could have been selected for the enterprising corps of young men who dash in and out of its grimy doors. They defy even death itself in their efforts to give the public the flickering story of the latest news happenings. Dramas of a wholesome sort are enacted before the camera on the floors above; but that part of the organization will be taken up briefly later.

Publishing a moving picture news film involves vastly different methods than producing a newspaper or a magazine, although the contrary belief is usually held. News events often happen which cannot be told in a filmed narrative at all interestingly. An individual suddenly made important by some stroke of genius or luck is rarely handsome enough to hold attention very long on a screen—three or four feet of him is usually sufficient. Here, the background is vitally important. For example, if he is photographed on the steps of a capitol building, or as he is walking down the busy street of a city, then the picture will demand attention. The camera man, obviously, must have a well-developed "nose for news," which means that he must have had newspaper experience in order to understand the technique of building up a story properly. He must gauge his subject carefully; then focus his camera from the most interesting angle.

Animated News Getters

Six expert moving picture photographers are constantly within call of the "Animated Weekly" office, ready to be sent out on assignments at a moment's notice, day or night. Their orders come from the Editor, Mr. Jack Cohn, whose ideas and ideals quite typify the periodical. His nickname is not elegant, but it is none-the-less complimentary: "Live Wire Jack Cohn," he is called.

Mr. Cohn's latest creation for the advancement of the Art makes possible the feat of taking pictures from an automobile travelling at a high rate of speed. It consists of a square plate of metal, fastened to the floor of the car, and two strong upright rods to which the camera man is securely strapped. Remarkably steady pictures have been taken from the automobile when it was speeding at a rate of more than forty miles an hour. The road must be quite smooth, of course, for successful photography of this sort.

The First Man on the Eitel

The risks which the "Animated" reportorial staff will take and have taken to secure news photographs are occasionally quite hair-raising.

"The first man aboard the *Prinz Eitel Friedrich,* when she came into Newport Harbor," Mr. Cohn said with unassumed pride, "came from this office. He was put off the boat—with force—three times. But he got the pictures just the same. He knew it was 'up to him' to get photographs—and he brought back some dandies. I think the Captain would shoot him if he put foot on board again!"

A Trip on a Derrick

"My men always bring back the pictures they're sent for." He smiled. "It's worth their jobs if they don't. Sometimes they must scale the side of a building, or, as one man had the experience lately, they may even be hoisted in derricks. He was sent to Nicholson, Pa., to take pictures of a new bridge. There was no way out of it except for him to be hoisted, as they hoist beams, 350 feet into the air. He spun around several times on the way up, and got some excellent panoramas as the result. To keep grinding, no matter what happens, soon becomes a matter of instinct—of second nature—with a good camera man."

A Somersault in a Motor Boat

"Another time—it happened last summer—one of our reporters was sent to Lake George to get pictures of the speed boat races. He was in a swift hydroplane going at the rate of 43 miles an hour, when another speed boat—Blackton's *Speed Demon*—crossed the bow,

Editor Jack Cohn of the Animated Weekly and His Staff of Photographic Reporters.

and the tremendous wake tossed the boat he was in so high into the air that it turned a complete somersault! The camera man, with the heavy camera and tripod, was thrown forty feet through the air. Fortunately, he was a good swimmer; but a leg of the tripod had caught in his coat, and the sixty pounds of weight commenced to drag him down."

"What happened?" I gasped.

"Why," smiled my informant, "he removed his coat—and the camera sunk. When they pulled him out of the water he was unconscious. I think they rolled him over an old gasoline barrel, to get the water out—there wasn't a pulmotor within a hundred miles."

"And the camera?"

"We offered a reward of $200 for the camera, and every grappling hook on Lake George was sharpened up and put into service. Finally, we were compelled to hire a diver from New York. He was down three hours before he found it. And, strange to say, although the camera had been in water for three days, the film was in excellent condition—and we exhibited the Lake George race pictures all over the country!

A Camera Saved His Life

"Perhaps the most thrilling experience I can tell you about a camera man happened during a fierce chemical fire down on the waterfront. In an effort to secure an exciting rescue scene—dragging people who were overcome by smoke out of the building—he climbed to the roof of the building opposite. The view was partially obstructed by a chimney and a huge cornice; so, using his camera tripod as a balance, the camera man walked along a narrow ledge to a building nearer the fire. The building, it seemed, was one of the old-fashioned peaked roof mansions which had been transformed into a tea commission house. The gutter was rusty tin—and it suddenly gave way under his weight. Sixty feet below, the engines were fiercely pumping streams of water into the building. Hundreds of people in the street stood breathlessly watching the imperiled camera man. Quick thinking saved the day. He tossed the camera forward, catching it in the upper part of the chimney. Through sheer luck, it held, and he hung, dangling

from a leg of the tripod. By this time a number of the women in the street below had fainted. But he crawled back to the roof, and to safety, then went on taking the picture as if nothing at all had happened. Later, he admitted that he'd had a close call; but he claimed he had the best fire picture ever taken, and I guess he was right.

"It might interest you to know that we answer every two-alarm fire in Greater New York. An automobile is always ready to hustle an operator to the scene of the fire. Lots of them, of course, are not of any value to us, but we are always on hand in case anything does happen."

The Captain Was Wrong

"Do you remember when the dreadnaught *Wyoming* was put into commission, just recently? I sent one of the men down to cover the target practice off the Virginia Capes. The Captain of the *Wyoming* told the camera man the safest place on board from which to film the big guns in action was amidships, between the fore and aft turrets, on top of the galley roof. But the Captain had erred in his reckoning. When the *Wyoming* was opposite the target, a ten-gun broadside boomed out. The back draught caught the camera man, camera and all, blew him off the galley on to the deck and dislocated his wrist. The camera was smashed, port holes were staved in, deck planks were torn out, and a large hole was blown in the hull of one of the cutters. Almost a death in the family, too, as the cat mascot, in fright, jumped into the sea!

"Our photographers with Villa and Carranza in Mexico have had some lively experiences. We call them the 'bullet dodgers,' although they know that tact, properly used, will save them that trouble. Once, near Vera Cruz, one of the operators' film supply became exhausted. He borrowed a hand-car, and with the aid of a *mozo*, made the dangerous ride to Vera Cruz and back. On the return trip he was held up by a detachment of Mexicans. But the officer in charge at once recognized him as a 'movie operator' and allowed him to proceed. Moving picture operators, you know, are not at all unpopular in Mexico. From all reports, it appears to me that more shooting is done down there with films than with bullets.

Taking Motion Pictures from a Fast Moving Automobile has been Rendered Practicable Through the Use of an Iron Framework in which the Camera Man is Strapped.

Camera Man Filming Action from an Ice Boat.

"Of course, you must understand that these incidents I have told you about are by no means rare occurrences—they happen every day in the week. Here's a man, for instance,"—he handed me a photograph that was lying on his desk—"who is ready to take pictures from the bow of an iceboat—one of the fastest in the world. It can clip off a speed equal to that of an express train. That camera, by the way, is the one we fished out of Lake George, and we are very fond of it. It is the best moving picture camera I have ever seen."

The camera, luckily, was on its tripod in the office at that moment, its small, sunken eye looking gloomily out over the room. What exciting adventures that tell-tale eye has been the witness to! The wooden box itself was badly scarred and scratched.

"We call it the 'cigar box camera,' " he went on, "because it is so compact and light; not more than a third of the size of the usual motion picture camera, yet it cost over $600.

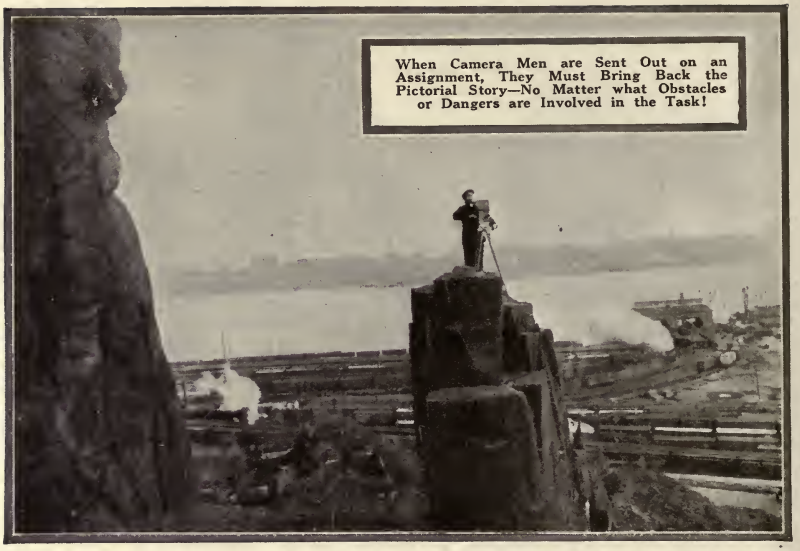
"Before long, we expect to use the new gyroscopic camera. No cranking is necessary. The operator merely tucks it under his arm and walks casually about. In this way, he is put on an equal basis with the ordinary news photographers; he is not compelled to erect a clumsy tripod and run the risk of having the crowd come between his camera and the object of interest."

A Case of Unmistaken Identity

"The broad scope of our system is one of the main reasons for our being in existence. We have representatives—always on the alert for news happenings—in all of the largest cities, besides 172 contributors, or correspondents, scattered throughout the country.

"Speaking of the scope of our system—or the smallness of the world, if you will—let me tell you about a lost child we restored to its parents. Last summer we sent a man down to Atlantic City, and when his film was reproduced, a man in a small town near here recognized his child, who had been lost for several months. At his request, we enlarged a portion of the film and by means of a little detective work the child was found and taken back to its home.

"Contributions come in by the score from our representatives and correspondents every week. Most of these contributions, as is the case with contributions to the popular magazines, are not usable. My hardest work is to edit these—to select the good from the bad." He pointed to a large heap of



When Camera Men are Sent Out on an Assignment, They Must Bring Back the Pictorial Story—No Matter what Obstacles or Dangers are Involved in the Task!

round, flat tins, stamped and addressed for mailing. "All those have rejection slips," he explained. "This week, I could only use five out of sixty that were submitted."

The Pearl in the Oyster

With respect to the "Imp" studios, to which passing reference has been made, these are situated on the two floors above the "Animated Weekly" office. Certain individuality can be claimed for them in the fact that they are probably the most difficult studios in America to gain entrance to. There is no name-plate on the door—only the glaring blue label of a detective agency, which lends further discouragement to the prospective sight-seer.

Outwardly, the building is forbidding and gloomy. You could pass by it a hundred times without suspecting that drama — genuinely good drama — was being made on the other side of the wall. In the waiting room—beyond the tall, locked rail—twenty florid signs, worded in twenty different ways, agree on the single thought that you—Y-O-U—are positively not wanted. Y-O-U are rather discouraged, until the czar at the gate gruffly invites you to enter, and you are taken in charge by an affable guide.

I must confess that the "Imp" studios —as studios go—are not vastly different, at least to the lay eye. There is the rather temperamental camera man, standing beside his machine, looking very bored; the thickly rouged players, who talk shop incessantly; the flood of ghastly blue-green light from the luminous Cooper-Hewitts; the excitable and profane Director. But I am wrong there! The Director-in-charge at the Imp is neither excitable nor profane. He is an anomaly in the form of the kindliest, most-likable man you could ever desire to meet. He is gentle and patient, with a generous crop of fatherly white hair—and his results are wonderful. He speaks in a voice low and soothing. Contrasted to the usual fiery and redundantly profane director-type, he is a decidedly pleasant surprise.

Mary Fuller was rehearsing a part that afternoon in the play "A Girl With a Soul." Talk with Mary for two sentences and you will never gasp at the mention of her salary! She fairly vibrates with personality—an unassumed, girlish *pétillante*—yet she can be serious and sympathetic when her part requires

it. A remarkable fact about Miss Fuller is that you would not recognize her, no matter how familiar her face may be, if she should pass you on the street. I do not mean that she is not equally as attractive off the screen as on, but that her features seem to have an entirely different cast.

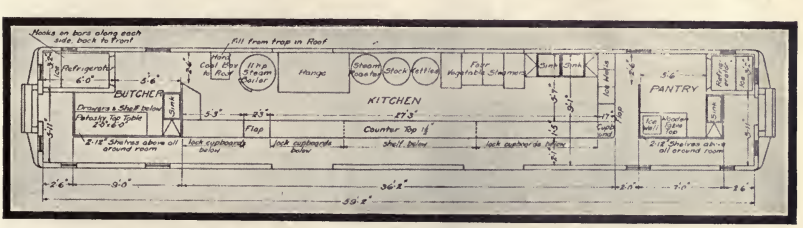
Utter quiet is an unyielding rule at the Imp studio. The moment the Director utters the electrical command, "Camera!" all talking must cease. That is one reason, probably, why the "Imp" does not welcome visitors with open arms.

As plans are shaping now, by the time this issue of the magazine comes from the press the gloomy structure down by the waterfront which now houses the "Imp" will be hardly more than a dark memory. Necessity, years ago, demanded the old building in its unbeautiful surroundings of factories, warehouses and corner saloons. But a greater necessity has arisen, and it has been answered in the mammoth new concrete-and-steel plant of the Universal Company in New Jersey.

It will be one of the greatest moving picture factories in the world, reflecting not alone the ideas of the men who are making it, but the spirit of the fearless band of youthful *entrepreneurs* who have fostered and who were at the beginning the source of the regeneration of the movies.

MILITARY COMMISSARY KITCHEN CARS.

IN transporting the troops from various points in Canada to the concentration camp at Valcartier, Quebec, a big problem was presented. While the transportation of the troops itself was a considerable task, the problem of feeding the men through the journey pre-



Plan of a Commissary Kitchen Car Used by the Canadian Government in Connection with the Troop Trains. Several of these Cars have been Provided by the Canadian Pacific Railway Company, through the Conversion of Standard Baggage Cars.

sented greater difficulties, as none of the existing railway equipment could be directly used for the service, the dining car service being entirely inadequate and unsuited to the requirements. The Canadian Pacific Railway Company solved the difficulty by converting standard 60-foot baggage cars into commissary kitchen cars. This conversion was made at the company's own shops in Montreal, Quebec. The layout of the cars is shown in the illustration.

Each of the cars is a well appointed hotel kitchen on wheels, and comprises three main sections: kitchen proper, butcher shop and pantry. The interior corridor arrangement resembles the company's compartment cars, since from each end the passage leads from the central entrance way and along a 2 ft. 1 inch corridor on one side of the car. The two baggage door openings on the corridor side are fitted with permanent screens for ventilation purposes, and the similar openings on the other side have been blocked up.

The butcher shop and pantry are in

partitioned off rooms, while between the two is the main part of the kitchen. Along the corridor side of this kitchen is a full length counter, fitted with two flap entrances, with cupboards and shelves below. Along the blind wall of the car is arranged the cooking apparatus, consisting of steam roaster, two stock kettles, four vegetable steamers, a large range and other facilities. These are nearly midway in the kitchen proper, with two sinks at one end and an 11 horsepower vertical steam boiler, with adjacent hard coal bin, at the other end, for supplying steam to the cookers.

The butcher shop contains a large table, a sink in one corner and a refrigerator at the other, in which the meat is kept fresh. The pantry at the other end of the car contains a table, a sink and a smaller refrigerator. It has two 12-inch shelves around the room.

The agateware plates used are suspended from the roof, and the shelves and cupboards under the counter are used for storing plates, saucers and dishes of various kinds, and also the knives, forks and spoons. The orderlies' soup and coffee carrying cans are suspended directly over the counter. Vegetables are stored in boxes underneath the car. In addition to an overhead storage of water, there are suspended beneath the car three tanks of water, giving a total capacity of 1,490 imperial gallons. All the sinks have a supply of both hot and cold water. The windows and doors are equipped with screens to keep out insect pests.

For serving the meals the orderlies from each company file in from one end of the car, line up in front of the counter, are allotted the portions for their men, and pass out of the other end as rapidly as served. The operation of the car is said to be most satisfactory and exceeds the expectations. The capacity of each car is three meals a day for 1,000 soldiers. The crew consists of twelve men, headed by a steward, one of the twelve being a boiler man and the others serving as cooks.

A SUGGESTION FOR THE HOME

Wishing to train her baby daughter to be independent and to understand early in life the care of her own room, and yet not wanting to leave the child in a separate room where she might throw the covers off and become cold in the night, a Californian woman had a special window, without glass, cut in the wall between her own room and the one she gave to the child. By placing her own bed beside the window and the child's little bed next to the window on the other side of the wall, she can keep watch over her in the night. The child learns the lesson of having a room of her own, thus developing individuality, but for the first few years of her life her mother will use this means of seeing that she does not catch cold. The simple style in which many of the Californian beach bungalows are built, the walls being of one thickness of redwood, makes it easy to cut a window like this in a few minutes.

Although in a Separate Room and Deriving the Consequent Benefits, the Child may be Observed by the Mother.

A Notable Achievement in Deep Sea Salvage

by Robert G. Skerrett

ENTERPRISES for bringing up the treasure of foundered ships are not lacking in number. But how many are successful? Most of them never reach beyond the stage of securing capital for the project; few actually make an attempt at working the wreck under consideration, and still fewer are a success in any degree. Here, however, is a striking exception. Silver bullion carried down in the ill-fated "Empress of Ireland" has been salvaged by a most remarkable undertaking.

THANKS to the leadership of an American engineer, Mr. William W. Wotherspoon, the Canadian Salvage Association has recently finished a notable achievement in deep-water salvage. Indeed, the work done is another proof of what science makes their activities, the film producers are remarkable performance, let us see how the state of the art has suddenly advanced from a standard set a good many years ago.

The work of the submarine diver has always made a strong appeal to popular interest, and the hazards run have given an element of fascination to this field of human activity. In February of 1884, the Spanish liner *Alphonso XII* foundered off the Canaries when bound for Cuba with a very valuable consignment of specie aboard. To be exact, she had a half a million dollars in newly minted coin. She sank in twenty-six fathoms of water—a matter of 156 feet. The salvage operations covered an interval of about thirteen months, and the only diver found capable of doing the work, a man named Lambert, made on an average something like two descents a month. Even so, he suffered from the hydrostatic pressure to which he was subjected, and at times was completely played out when he reached the surface. Indeed, he paid the price of his venture-someness and was paralyzed shortly after his dangerous task was finished.

From the specie room of the sunken *Empress of Ireland*, Mr. Wotherspoon's associates have recovered the silver bullion and the purser's safe—not to mention the salvage of the pouches of postal matter and the reclaiming of hundreds of bodies of the stricken passengers. To reach the specie room the divers had to descend to a depth of 160 feet; they had to break their way into the craft and to follow a devious passage; and it was nec-

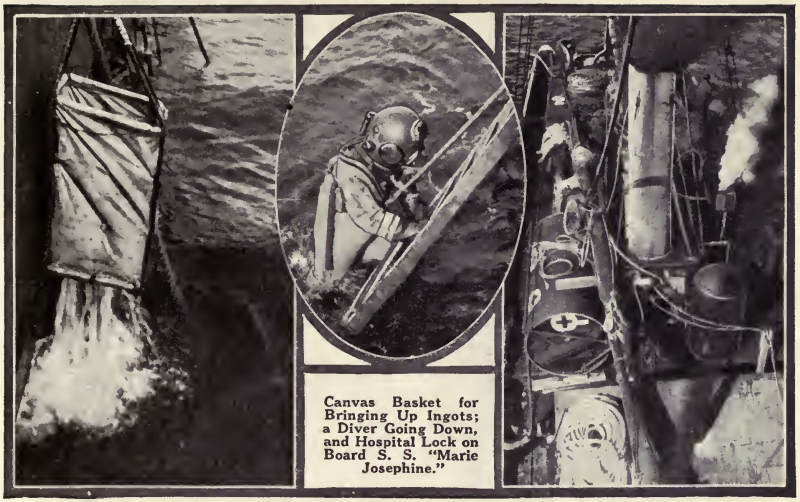
essary for them to work in extremely cold water and amid a gloom that was well-nigh inky. Instead of only one diver being engaged there were twelve of them, and the circumstances of their operations must be made still plainer in order that the layman may grasp the really extraordinary nature of the undertaking.

First, it was necessary to locate the position of the foundered ship in relation to the channel and then definitely to establish the manner in which she was resting on the bottom. The Canadian Government had planted wreck buoys a few hours after the *Empress of Ireland* went down, but these merely indicated in a general way the area in which she lay. Now, the St. Lawrence has a normal rise and fall of more than 14 feet where the liner sank, and this means a very strong current at the ebb and flow. Accordingly, only a brief interval of something like half an hour was available at the slack of the tide when diving operations could be carried out in comparatively still water. The first diver that went down to locate the wreck hit the bilge keel and then dropped off into deeper water where he hung without being able to tell anything. It was the red paint on his suit and his description of the projection that revealed the bilge keel and proved that the steamer lay turned over and flat upon her injured side.

The Divers Engaged in the Work were Instructed by Means of a Cardboard Model of the Section of the Wreck Containing the Treasure.

The next problem was to find out how the hull lay in relation to the tideway, and this was no easy task in the dark depths of the river. More than once the divers became bewildered as they groped their way over the upturned ship and tried to identify the different portions of her. To add to the grewsomeness of their job, they stumbled every now and then upon huddled groups of victims held in the open spaces between the promenade deck, and kindred fairways. It was in recovering some of these bodies that one of the divers lost his life—the only fatality that occurred during this extremely difficult and hazardous enterprise. That man's death taught an early and a very valuable lesson. He was a splendid physical specimen of manhood, a very careful liver, and an experienced under-water worker. While walking along the slimy side of the liner he slipped and dropped suddenly to a greater depth. Possibly he was frightened or more likely stunned by the instantaneous "squeeze" of water pressure. Be that as it may, he instinctively tried to do what the emergency called for, *i. e.,* to open wider his air supply valve and thus equalize the external pressure by increased air pressure within his suit.

Unhappily, in his confusion he turned his valve the wrong way! He shut off his air instead of increasing the vital flow. He was very strong and by struggling more and more in the wrong direction he finally wrenched off the little wheel and thus sealed his fate. Before relief could be sent to him he was too far gone to be saved. That accident established the rule thereafter that the divers should work in pairs, and it also led to a trifling modification in the equipment which justified itself several times afterwards. The valve was so arranged that it would not be completely closed, and thus a sufficient leakage was insured which would keep



Canvas Basket for Bringing Up Ingots; a Diver Going Down, and Hospital Lock on Board S. S. "Marie Josephine."

the man alive if, by chance or confusion, he repeated the unfortunate manœuvre of his ill-fated associate. This simple expedient had not been thought of before, despite all of the years in which divers have toiled at their dangerous calling.

Shortly after the wreck of the *Empress of Ireland* was accurately located, her cargo shifted, and this raised the hull to a part-way upright position while the craft sank deeper into the mud. This added to the difficulties of the salvors, because they had planned to cut a hole in the upturned side of the vessel for the purpose of getting into the specie room and the mail room. The diagram accompanying this article shows the final position of the ship in a vertical direction. The slanting side of the hull offered a very ticklish footing for the divers, and besides this they had the puzzling problem of locating a particular airport, among scores of others, that marked where a crosswise passage in the body of the boat extended from the skin plating inboard to a fore-and-aft gangway forming the most direct and logical route to the places where the mail bags and the specie were to be found. The identification was ultimately accomplished by having the divers work from both ends of the ship toward their objective—counting each airport on the way. Little electric submarine lamps helped them amid the frigid gloom in which they labored.

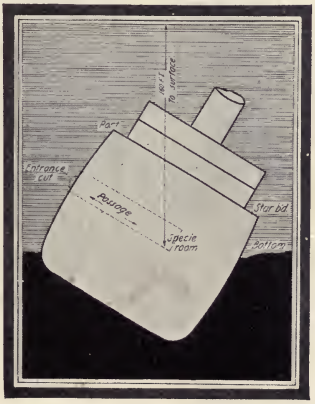


Diagram of the Location of the Treasure in the Wreck of the "Empress of Ireland."

By means of pneumatic drills, the divers finally cut a good big hole in the outside plating at the proper point, but the salvage engineers were not yet ready to let the men undertake the recovery of the bullion and the purser's safe. There were too many openings

Members of the Salvage Crew and the Treasure They Brought to the Surface from the Sunken Steamer.

along that route into which the divers might turn by accident and get lost or entangle their air hose and lifelines. Accordingly, the menacing doorways were sealed and the longitudinal gangway bulkheaded off so that the operators would have a straight path to the first-class baggage room and then a comparatively easy route into the mail and the specie rooms. This was not all that was done in the name of safety. A pasteboard model of the internal structure adjacent to and forming part of the divers' pathway was fashioned, and one by one the men were made to familiarize themselves with the physical situation, so that they could describe every part of the way and tell just what they would have to do to get in or out if caught there without their hand lamps or should the lamps fail them.

Possibly you do not know it, but a diver is guided to a great extent in dark or muddy waters by his sense of touch, and therefore his hands are commonly bare. The water about the wreck of the *Empress of Ireland,* however, was so cold that the men's hands soon became numb and their usefulness hampered proportionately. To overcome this difficulty, they were finally provided with rubber mittens of American make sufficiently thick to protect the hands and yet thin enough to permit of satisfactory tactile acuteness. Scores of pairs of these mittens were used up during the operations. Finally, when everything was in readiness, the divers went into the specie room and got out the ingots of silver and into the mail room where they recovered the pouches of postal matter, but the biggest problem was that of removing the purser's safe. The divers could not do any strenuous work themselves, and the safe had to be pulled out of its resting place and then drawn through the succeeding doorways and along the passage leading to the cut in the side of the ship before it could be lifted directly surfaceward. The power had to come from the salvage steamer above, and a wire hawser was the connecting medium.

The little plan of the upper deck shows the round-about route for the safe, and the ticklish part of the job lay in exerting a uniform pull on the line. Any jerky motion due to careless control of the hoisting engine might have jammed

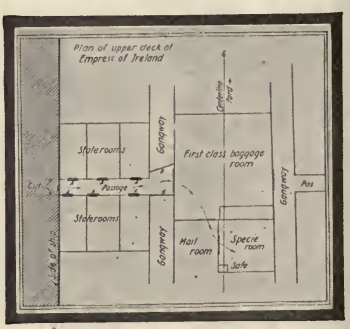


Diagram of a Section of the "Empress of Ireland," Showing the Relative Position of the Specie Room.

the safe or have snapped the wire rope, to the imminent peril of the divers, and but for the telephone equipment employed it would have been well-nigh im-

possible to have executed the work as quickly and as efficiently as it was done. By means of the submarine telephones used, which in themselves were the latest thing in the art and modified on the spot to agree with the best American practice, continual communication was maintained between the men below and the responsible officers on the salvage vessel and, at the same time, by means of a relay, the two divers of a working couple could talk to each other. This facility of vocal intercourse aided materially in the carrying out of the work and insured complete co-operation at every stage. The men did not have to depend upon signals transmitted by means of pulls on the lifeline; there was no chance for misunderstanding, because every order was by word of mouth.

In the past, it has been the uniform practice to supply the divers with air by means of hand-driven pumps. When working at moderate depths, this is not such a hard thing to do, but when the under-water workers are down 150 feet and more it takes the continual efforts of four men at the cranks to supply enough air for two divers. Indeed, the maintenance of the supply is a burdensome task, and the four men soon become exhausted by their labors. If the air should fail it is perfectly plain that the divers would be in grave peril unless they could be brought quickly to the surface or speedily succored by a renewed flow. To overcome this difficulty the Canadian Salvage Association availed itself of experiments made by the United States Navy.

Instead of using hand-driven pumps, steam compressors were employed which stored the needful air in two large tanks, and from this abundant source of supply the divers were fed. In this way all danger of either a failure of vital air or

Below: One of the Submarine Telephone Switchboards which Played an Important Part in the Undertaking.

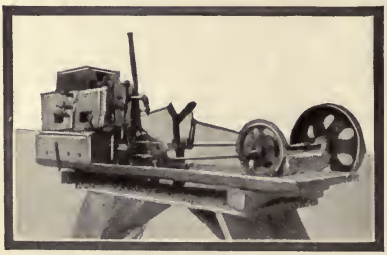
Above: Bringing Up the Purser's Safe—The Climax of this Difficult and Remarkable Undertaking which has Set a New Record in Salvaging Operations.

a sufficiency of it was obviated, and a material advance in the art of submarine operations effected. Apart from that, there was a gain in economy, because the steam-driven compressors could do their work much better and cheaper than the gangs of men otherwise needed to work the hand pumps. By means of reducing valves placed between the reservoirs and the air hose leading to the helmets, a safe maximum pressure was secured which was just a trifle in excess of that required for the deepest submergence of 160 feet, and then the quantity of air was left entirely to the control of the divers—each man regulating the flow to suit his individual needs and the conditions under which he was working. An insufficiency of air has been the cause of a great many diving disasters, and it was only a few years ago that the British Admiralty demonstrated that most of the hand pumps supplying under-water workers were unequal to the drain imposed upon them for really deep submergences. The pumps failed to supply to the diver all the air he needed, while their gauges indicated the contrary—a state of affairs that is obviously dangerous in the extreme.

Apart from the value of the present accomplishment, the task carried through by the Canadian Salvage Association on the sunken *Empress of Ireland* is of suggestive importance, because wrecks that have hitherto been abandoned without an effort could have been worked upon in the light of the state of the art to-day, and vessels that may be lost under kindred conditions hereafter will be within the reach of the scientific salvor.

STEAM ENGINE BUILT WITH SIMPLE TOOLS

With the aid of a hack saw, a file and several drills, a youthful mechanic constructed the model steam engine which is the subject of the accompanying illustration. Notwithstanding the crudeness of the tools and material, it will run and generate a small amount of power. It was built along the line of the Stevenson link motion engine, having a reverse rod and valve gear. The boiler was made from short pieces of iron pipe.



A Model Steam Engine Built by a Youth with the Aid of Crude Tools.

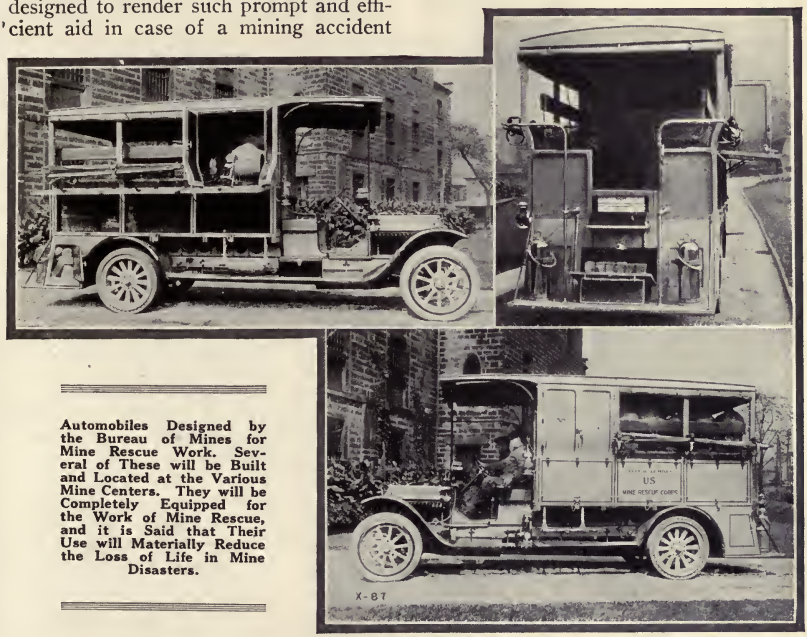
ALUNDUM

Alundum is an electrically fused alumina of exceptional purity and great power of resistance to heat. It is used in the making of furnaces and other objects in which a material able to withstand excessive temperatures is required. It is made by calcining bauxite and fusing it in a water-cooled electric furnace. The less pure products are used for abrasive purposes. Alundum comes from the furnaces in pigs of five tons each, which are crushed and molded with a refractory bond of a ceramic nature. Attempts to make articles of cast alundum have been only partly successful in the past.

AN AUTOMOBILE EQUIPPED FOR MINE RESCUE WORK

There is an abundance of talk in these times about the wonderful completeness of rescue work and appliances for the aid of the injured in war. On the other hand, but little is said about first-aid for those who fall in the battle for livelihood. It is well known that mining is a hazard-

ous occupation, particularly coal mining, in which the mortality is high. The U. S. Bureau of Mines, whose first thought is the reduction of mining mortality, has had built a type of automobile designed to render such prompt and efficient aid in case of a mining accident



Automobiles Designed by the Bureau of Mines for Mine Rescue Work. Several of These will be Built and Located at the Various Mine Centers. They will be Completely Equipped for the Work of Mine Rescue, and it is Said that Their Use will Materially Reduce the Loss of Life in Mine Disasters.

that the percentage of life losses will be materially cut down. These automobiles are to be stationed in mining centers where they can reach the scene of an accident very promptly. They are to be manned by a crew of trained experts in saving life, and are equipped with all the apparatus required to give aid to the injured. They carry drugs, bandages, stretchers and a wonderful variety of scientific paraphernalia, such as pulmotors, oxygen pumps, tanks, respirators, fire extinguishers, explosive materials, a complete underground telephone system, full stock of miners' and firemen's tools, and in short everything to aid in succoring the wounded.

If you enjoy THE WORLD'S ADVANCE, tell others; if not, tell us.

"SOLIDS"

The usual assumption has been that changes in the volumes of "solids" are due to changes in the extent of empty spaces between the molecules. But, within recent years, there has been a tendency to question this assumption. It is asked whether, after all, there are any such empty spaces in solids and liquids. One authority, after discussing the phenomenon of porosity, goes on to say that the ordinary conception of a solid has always seemed to him little short of absurd. The most reasonable conclusion, it seems, is that in solids and liquids the interstices between the atoms are usually small in proportion to the sizes of the atoms themselves, even if there are any interstices at all. This authority has suggested the alternative hypothesis that atoms are compressible. If that be the case, they should be able to contract and expand or vibrate within themselves, even when their surfaces are prevented from moving by being closely packed.

A New Type of Railroad Crossing Signal in which the Arms Change Position to Warn Oncoming Pedestrians and Drivers.

DANGER SIGNAL FOR RAILROAD CROSSING

The danger signal shown in the accompanying illustration was erected at the intersection of a railroad line and automobile road. As a train enters the danger zone the signal reads "STOP, DANGER," and at other times, "SLOW, CAUTION." In the view the blades may be seen changing position as a car is approaching. As a further warning and protection, a bell rings during the day, while at night a system of lights is employed, a red light flashing out when the bell rings.

A new Italian wireless telephone system employs a call bell with an effective range of 40 miles.

RAISING BUTTERFLIES FOR PAGEANT

The students of the University of California are preparing for a large, open-air pageant which will require the use of hundreds of live butterflies. In order to secure such a vast number of insects the students are canvassing the campus for cocoons and will raise the butterflies from these under the direct supervision of the Entomology Department. Such an undertaking has never been attempted before, and the Pacific Coast entomological societies are watching with eager eyes for the result of this novel experiment. The number of butterflies needed is about 4,000.

NOVEL MASSAGING MACHINE

A novel massaging machine devised by an invalid-inventor permits a patient to massage his own back. The patient reclines on a "chair" consisting of a strip of heavy fabric stretched between and supported by adjustable frames. In the rear of this "chair" back, massage rollers are provided which are under the control and may be operated by the patient. Levers which the patient may grasp extend back and connect with the device on which the rollers are mounted. The whole device is resiliently mounted so that the pressure to be applied in massaging is wholly under the control of the operator-patient. The contrivance is intended to stimulate the blood circulation and produce a consequent beneficial ef-

By Means of this Newly Invented Device, a Patient can Massage His or Her Own Back.

fect on injured nerves through the effect of massage on the spinal column. The chair frame is slidably mounted so that the patient can push himself backward or forward to regulate the vigorousness of the massage.

RECORDING WEATHER BY ELECTRICITY

An illustration of Uncle Sam's efficiency in the management of one hundred and eighty-five millions of acres of land included in the National Forests are the electrically-operated weather stations. In classifying the National Forests for grazing, agriculture and other uses by the people, an accurate knowledge of snowfall and rainfall and temperature is required, and for this purpose many weather stations are maintained. They comprise an anemometer which notes the velocity and duration of the wind, a wind vane, thermometers

Examples of the United States Government's Efficiency in Managing the National Forests: In the Oval is Shown One of the Many Graduated Poles for Measuring the Fall of Snow; at the Right is Seen the Apparatus for the Recording of Rain-Fall, Velocity of the Wind, and the Temperature. These Instruments are Connected by Wire to a Station Some Miles Away.

WANTED—SPECIAL MOULDING SAND

A sand is wanted to take the place of "French Sand" for fine statuary casting in bronze. The sand imported from France for this purpose contains about 80 per cent. silica and 20 per cent. alumina. It is a prepared mixture of very fine clay and sand. When slightly damp it feels like putty if crushed between the fingers.

and rain gauge. All of these instruments are connected by wires with the station, some distance away, where an electrical device makes a minute and mathematically correct record. A recent addition to the equipment of the stations are the snow gauges which have been placed in the high altitudes where it is important to know the depth of the snow in order to determine the practicability of opening the land to homesteaders.

NOVEL CONTROL FOR DUMBWAITERS

In one of New York's big department stores there are fourteen electric dumbwaiters, all of which are under the instant control of a single operator at a central switchboard. In this switchboard there is one vertical panel of control buttons and lights for each dumbwaiter; the round bull's-eye at the bottom of each panel is the pilot light for that dumbwaiter, showing whether the latter is in operation or closed.

The buttons at the right-hand side of the lower half of each panel are the controlling buttons for dispatching and calling the car, and the buttons at the left are the signal buttons. Each button is connected to a buzzer at its proper floor, and the operator signals that the car is coming or that a door has been left open.

In the upper half of each panel there are three vertical rows of lights, red ones in the center and white ones at each side. The red lights are a position indicator and show the location of the car at all times. The lights on the right-hand side are the "call" signal lights. There is a button at each floor connected to its proper light and the attendants at the floor thus signal that the dumbwaiter is wanted. These "call" lights are so arranged that when the dumbwaiter car is sent to a floor it automatically cancels the call light of that particular floor, but if there should be any other calls they remain lighted and are only extinguished after the car has been sent to the other floor calling. The lights at the left-hand side are the "send" signal lights and are connected to a bank of buttons in the dumbwaiter car itself. They are used in inter-floor service, that is, the attendant on the floor will call the car to that floor, and when it arrives place the package therein and by means of these buttons and lights signals to the operator the floor at which the package is to be delivered. These lights are also arranged automatically to cancel themselves as soon as the car is sent to the floor wanted.

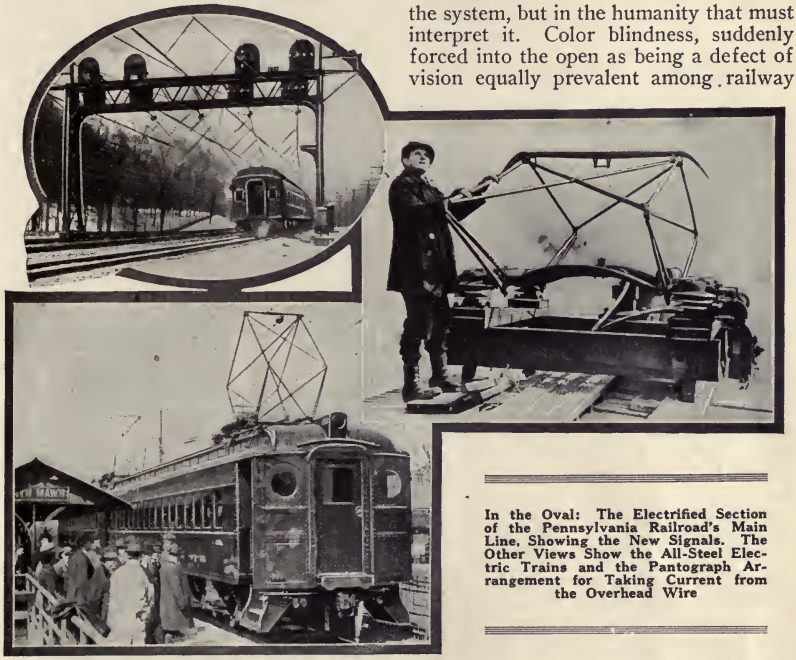
The Fourteen Dumbwaiters in a Large New York Department Store are All Controlled by a Girl Operative, Sitting Before a Large Switchboard.

It is stated on good authority that the method of range finding employed on American battleships is the best in the world. It is being kept a strict secret.

Railroad Safety in Pure White Light.

By Camillus Phillips

THE advent of a new era in railway safety is marked by the installation on the Main Line of the Pennsylvania Railroad of a signal system, for the present unique, which eliminates absolutely the dangers arising from color blindness by relying upon the use of one color only—white. The signaling is accomplished by means of the simple differentiation between light and darkness, all signals of the code being read in terms of vertical and horizontal white lights.



In the Oval: The Electrified Section of the Pennsylvania Railroad's Main Line, Showing the New Signals. The Other Views Show the All-Steel Electric Trains and the Pantograph Arrangement for Taking Current from the Overhead Wire

Until now the railway world has struggled ineffectually for absolute signal safety in the face of human sense limitations which are apparently unalterable. When the simple but crude mechanical contrivance of the signal arm was supplemented at night by the colored lights familiar to the block system, it was believed that the absolute safety sought was actually attained. Numberless accidents, costly in life and property, remained inexplicable until the advance of science revealed an inherent weakness—not in the system, but in the humanity that must interpret it. Color blindness, suddenly forced into the open as being a defect of vision equally prevalent among railway employees and the remainder of the population, had to be rated as a defect fatal to any career on the rail, and it rendered imperative the most rigid tests of vision throughout all branches of the service. Human knowledge then believed it was using the only precaution possible, and practicable, for the wiping out of humanity's proneness to error.

The ideal, however, remained unachieved; and it must remain unachieved until some device should appear which would do away wholly with the human color sense as a means of protection. The

problem appeared impossible of solution; yet the essentials of that solution were already a matter of ancient history to the manufacturers of electric signs as displayed profusely along Broadway, in New York.

The electrification of the Pennsylvania's Main Line is a matter of grave importance, not only to the immediate locality but to the road at large, for it concerns the crack service of the line and it affects probably the wealthiest body of commuters in the world. During a period of nearly two-score years the Pennsylvania Railroad has pursued consistently the policy of building up the stretch of country between Philadelphia and Paoli until it should include estates owned by all the wealth and fashion of the community; and now the land, for miles beyond the road's right of way, is a succession of magnificent country seats interspersed with properties rivalling the manorial holdings of England. Short as the electrified line is to Paoli, the new service required the building of 93 all-steel cars, to be in readiness for May 30, the opening day, with 54 trains outbound daily and 51 inbound. A considerable reduction in the running time of all inbound trains with the installation of the electrical service emphasized the need for some system of signalling which would be infallible. Apart from the necessity of safeguard in the face of higher speeds, the mere fact that the "trolley" wires are designed to carry 11,000 voltage and employees are warned that it is dangerous to come nearer than 14 inches of them gave an indication of the foresight which had to be exercised throughout the new system.

In the new signal apparatus no movable parts exist; the code is identical during every hour of the 24; and it is read in fixed, brilliant, white electric lights which define themselves sharply against a dead black background. By the use of vertical and horizontal light series it was easy to arrange a code of light signals which correspond in meanings to all semaphore arm positions—vertical, horizontal and diagonal. Every signal is equipped with lights in rows equivalent to the purposes of two semaphore arms.

Lights instantly burning and as instantly extinguished have long been a commonplace feature of street signs and preceded the new white light signals by many years. The utilization of the principle for railway protection involved, however, the vital feature of ample visibility in full daylight. That difficulty has been overcome by quadrupling the voltage during daylight hours. The white light signals, as they are in operation now, are clearly distinguishable in the most brilliant sunlight at a distance of 4,000 feet; at night, when the full current is used, large type can be read 1,000 feet away.

The lamps, spaced 18 inches apart, are up to 12 volts, with 4-candle power, 5-watt Mazda, concentrated filament and adjustable base. At night, they burn 3 volts; at twilight, 6 volts, and in bright daylight, 11 volts. They have special inverted 5⅜ inch lenses, with reflector mirror above the light, to throw down some of the rays for close range.

The engineer in control of every electric Main Line train receives his warning of a possible stop at a distance of 7,000 feet from the spot where ordinary caution calls for the halt, being confronted with at least two premonitory signals, each guarding a block of 3,500 feet, before he comes to the signal reading "Stop." When a train moves into a 3,500-foot block, the signal which it passes in entering sets itself automatically for the light code signal reading "Stop." As the train passes into the block beyond, the first sign shifts to the light code signal, "Caution." When the two full blocks have been left clear, the first signal announces track conditions accordingly.

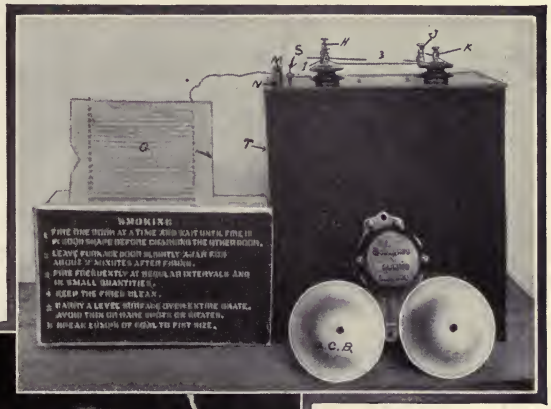
The new electric cars are equipped with a pantograph, thus being superior to the trolley pole used on the Pennsylvania's seashore line in New Jersey. The pantograph adjusts its working height automatically to the varying level of the catenary electric wires above the car's roof, as does the ordinary trolley pole with its wheel. But the flat, wide edge of contact which it presents to the wire permits of an enormous play in rounding curves, as compared with the pole and its grooved wheel, and renders it practically impossible to break contact with the wire above.

ELECTRICITY ABATES SMOKE

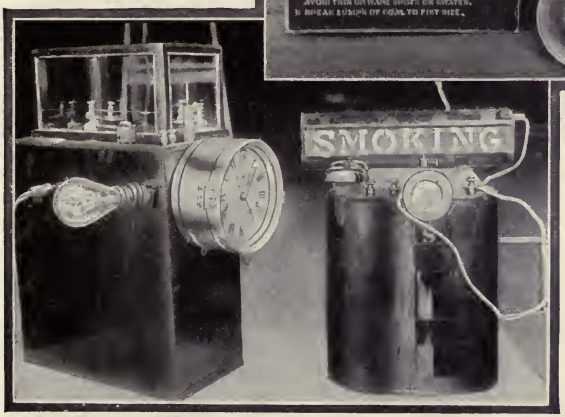
An interesting device known as the smoke monitor has been perfected, and while it does not do away with all the smoke belching from smokestacks, it aids in a great way in the fight against the soft-coal nuisance. The apparatus eliminates that part which does the most damage, and permits a clean, white column of vapor to rise from the factory stack, protecting its owner against a warning notice from the city smoke inspectors.

The first experiments were carried on at the Mellon Institute of Industrial Research; the treatment of Pittsburgh smoke, due mostly to the steel mills, and found to consist of from one-third to one-half of iron oxide, being first undertaken. With the application of a powerful current of electricity through the wires of the appliance, the small particles of iron oxide are changed to larger ones and by their own gravity fall into the furnace bed far below.

So far, various forms of the smoke monitor have been perfected. By the aid of a clock attachment the electric monitor will signal to the manager of the plant or the man in charge exactly how long the chimney has been smoking. The appliance accomplishes even more than this—it actually flashes electrically-lighted instructions for the proper and efficient firing of the furnace. Another design flashes the word "SMOKING" and at the same time rings an electric bell, attracting the attention of the fireman to the fact that he is not firing the furnace properly, and is sending a portion of the firm's good money out of the top of the smokestack.



At the Right: High Tension Transformer which Supplies the Electric Current that Serves to Minimize the Smoke Issuing from a Smokestack.

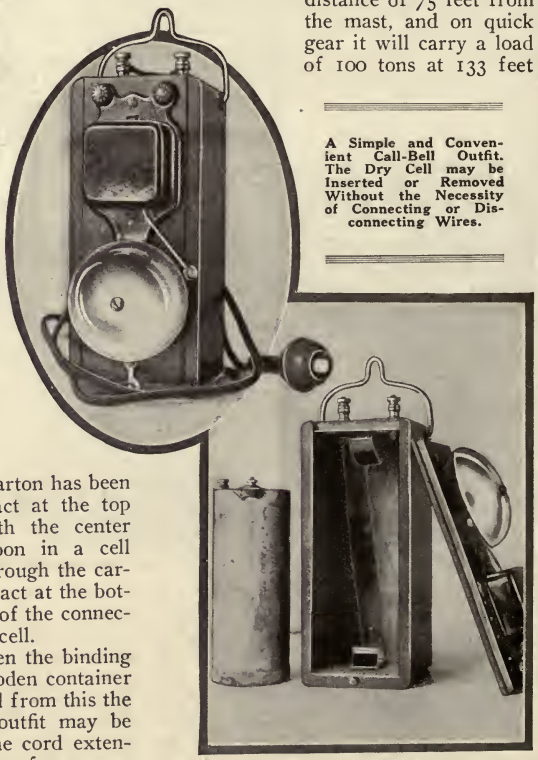


Two Designs of Smoke Monitors. One of These Informs the Man in Charge as to the Length of Time the Smokestack has been Smoking, While the Other Rings a Bell and Flashes the Word "Smoking" at the Same Time.

The electric monitor is not only efficient in lessening the smoke nuisance, but its action is effective upon cement and ore dust as well. The electric current used in the electric monitor is insignificant as compared to the results; at the rate of three cents per kilowatt hour the cost of operation is claimed to be no greater than one cent per day.

ELECTRIC CALL BELL OUTFIT.

The trend in the design of electrical novelties is clearly in the direction of greater simplicity and utility. While the devices strictly new in idea are comparatively limited in number, still the improvements in existing devices are many. An interesting example is seen in the accompanying illustrations. The inventor of this call bell outfit has combined a dry cell, bell, cord and push button into an outfit which is truly a marvel of simplicity and all-around utility.



A Simple and Convenient Call-Bell Outfit. The Dry Cell may be Inserted or Removed Without the Necessity of Connecting or Disconnecting Wires.

The battery is contained within a wooden case which carries the bell on its cover. The connections with the battery are effected merely by pushing the cell in place after its cardboard carton has been removed. A spring contact at the top establishes connection with the center binding post or the carbon in a cell wherein the post passes through the carbon. A second spring contact at the bottom of the case takes care of the connection with the zinc of the cell.

The bell is operated when the binding posts at the top of the wooden container are connected together, and from this the reader will see that the outfit may be used as a call bell with the cord extension and push, an auxiliary for an annunciator set, or it may be permanently installed as the door bell for a house, in which case the purchaser has only to run two wires from the door to the bell, connecting a push button at one end and the binding posts on the top of the case at the other. Thus it is quite necessary to devise ways and means for storing the battery in an inconspicuous place and likewise the layman in setting up the outfit is not required to install a special circuit of wiring, simple enough in itself but confusing at times to the uninitiated.

A GIANT CRANE

One of the hugest cranes in the world is that erected at Gavan, Scotland, on the river Clyde, for the Fairfield shipyards. On slow gear it will raise 200 tons at a distance of 75 feet from the mast, and on quick gear it will carry a load of 100 tons at 133 feet extension. The foundations of the crane consist of four large tubes, 15 feet through at the base, filled with concrete and sunk 74 feet below the surface.

THE wireless telephone has always toiled under an unlucky star. It was exploited before it was ready —a disastrous step for any new science to take. The recent unqualified success of the radio telephone on a moving train, however, should help tremendously in the living down of this unsavory past, and in paving the way to a much brighter future.

WHILE the Lackawanna Limited was travelling at high speed, one day in the early part of February, a man stood before a queer looking telephone in a small booth in the end of the smoking car. He was talking quietly, and frequently moving a little switch from side to side, and listening. Finally, he hung up the receiver with a smile of satisfaction.

"Just talked to Binghamton, twenty-seven miles away," he announced.

"Could you hear him clearly?" asked his companion, who had been waiting anxiously for the results.

"Clear as a bell!" was the answer. "And as soon as we get this"—he indicated some instrument on the machine—"in better running order, fifty miles will be just as easy!"

It was the first really successful exchange of wireless telephonic messages that had ever taken place from a moving train, and the train was moving considerably, too, at the time.

Last year, the Lackawanna, after a series of successful experiments in telegraphing without wires to and from one of their limited trains, decided to substitute wireless telephony in case it should prove feasible. The purpose of the intended change was, primarily, to obviate the necessity of adding a telegraph operator to the regular train crew. The Superintendent of Telegraphs of the Lackawanna, Mr. L. B. Foley, who has been for years an advocate of the commercial application of wireless to railroad work, estimated that the saving thus represented in one operator's salary equalled the interest at 6 per cent. on a $15,000 investment, and that therefore his road could well afford to go to the additional expense of equipping two of the limited trains on the New York-Buffalo run with radio telephone apparatus in place of the wireless telegraph.

The problem of designing and constructing a radio telephone that would measure up to the difficult requirements was put before Dr. Lee De Forest. The first wireless telephone designed for train work was installed at the Scranton wireless station of the railroad, and the voice of the speaker on one occasion was clearly heard on the train as far east as Stroudsburg, over 52 miles distant. The train during this test was travelling at a

speed of more than fifty miles an hour.

Recently, a De Forest train equipment was installed, and the results, which have been mentioned, are considered so satisfactory that a further extension to other trains of the Lackawanna system has been announced for the near future.

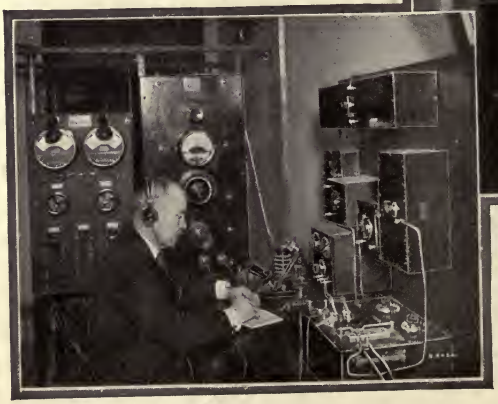
Emulating the Wire Telephone

In appearance, the equipment closely resembles the ordinary wall telephone, and in fact it was designed with that intention. It is quite compact, and all of the working parts are within easy reach of the operator. One of the principal aims of the inventor was to make the new telephone as fool-proof as possible; in effect, a person of no more than average skill can do all the manipulating necessary.

The adjustments of the wireless telephone are made on a sloping board on the front of the instrument. At the side, a quenched gap is installed. The quenched gap is a new creation of Dr. De Forest, at least for this particular use, and it takes the place of the troublesome oscillating arc formerly employed. It only requires an initial adjustment, after which it is securely locked to prevent tampering.

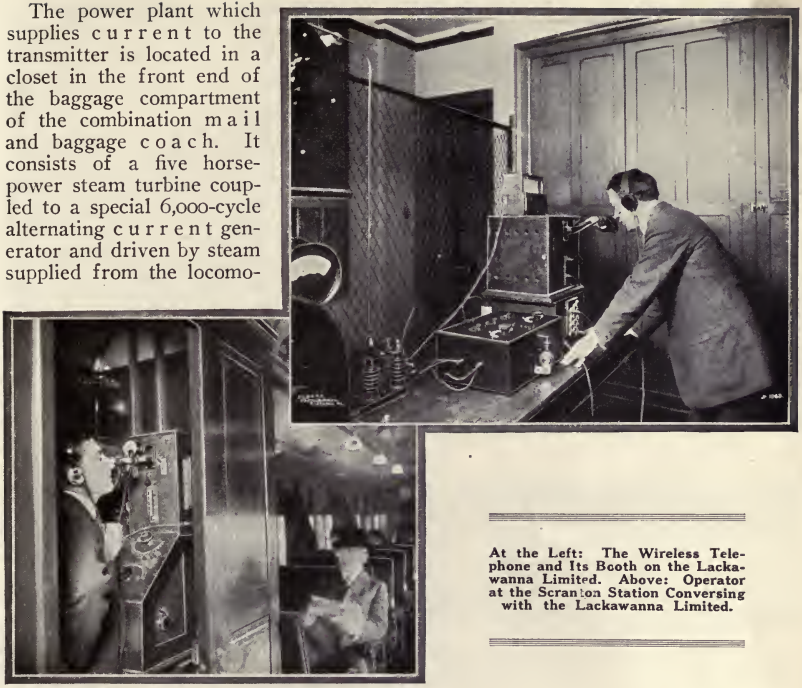
The radio transmitter is in the upper part of the instrument; the receiving instruments are in the lower part. An audion detector, another invention of Dr. De Forest, is employed. The usual pair of sensitive, high-resistance telephone receivers are used in connection with the audion.

The transmitting circuit is peculiar to this type of apparatus and does not embody the "tuned coupled circuits" usually employed in wireless transmitters. This novel circuit arrangement greatly simplifies the tuning of the transmitter. Moreover, the antenna system is not tuned to the primary, nor even "substantially in tune" with it; but the wavelength of the radiation may be varied through wide limits by merely shifting the contact switch located on the front of the transmitter case. When this is once set to the desired wave length, no further attention on the part of the speaker is required except to push down the little "listening switch" for talking, and to release it for listening. This switch also controls the filament-lighting current of the audion bulb, which thus becomes a visual signal to guide the speaker. He cannot telephone when the light is burning, nor can he receive when it is not lighted.



The Wireless Telegraph Apparatus on Board Train and at Scranton, Recently Replaced by the Wireless Telephone Equipment.

The power plant which supplies current to the transmitter is located in a closet in the front end of the baggage compartment of the combination mail and baggage coach. It consists of a five horse-power steam turbine coupled to a special 6,000-cycle alternating current generator and driven by steam supplied from the locomotive boiler. The turbine exhausts directly downward onto the track bed.



At the Left: The Wireless Telephone and Its Booth on the Lackawanna Limited. Above: Operator at the Scranton Station Conversing with the Lackawanna Limited.

The operating speed of the turbo-generator is necessarily high, being in the neighborhood of 2,500 r.p.m., a speed which is maintained within close limits by a special governor. A great deal of difficulty was encountered in designing this generator so that it would respond to the sudden and frequent switching of the load from full to practically zero, as the radio telephone apparatus is constantly changed from transmitting to receiving.

The antenna system is composed of four stranded wires stretched along the roofs of four coaches and held on porcelain insulators. An interesting feature in connection with the use of this aerial is that transmission and reception are accomplished with equal efficiency, whether the train is in a tunnel or travelling in the open air.

For the Travelling Public

An unique feature has been planned for the convenience of passengers who desire to communicate with friends who are not convenient to the nearest wireless telephone land station. By a retransmitting arrangement, the voice is transferred to the local telephone line, and, in fact, long distance calls can be handled to any distance in the same way. The cost of using the train-board radio telephone will, of course, be considerably more than for usual long distance service.

The Radio Telephone in Freight Service

Railroads throughout the country have already shown a keen interest in this pioneer work of the Lackawanna, especially for freight service, where, it is

General View of the Lackawanna Passenger Terminal at Hoboken, N. J., Across the Hudson River from New York City. The Aerial of the Wireless Telephone Installation is Strung Between the Steel Tower at the Right and the Tower at the Left.

claimed, a great economy can be effected even by the simplest one-way radio telephone service from signal towers to the cabooses of through freight trains. Each unnecessary stop that a long, heavy train is now compelled to make represents a loss to the road of from $20 to $30. It frequently happens that scheduled wayside stops of a "manifest" freight train could be avoided if it were possible to telephone the latest orders to the train crew while under full speed.

By a series of small radio telephone stations located at certain signal towers along the right of way, it would be possible to directly convey these orders verbally to the train engineers or conductors. Dr. De Forest has recently brought out a very small radio telephone transmitter which can be installed for less than $400, capable of telephoning to a caboose over a range of two to three miles. He estimated that a 500-mile railroad line can be fully equipped for such freight signalling service for an initial outlay of $30,000. The monthly interest on this sum is $125. Operating expenses of these small transmitters plus that of the caboose receiving stations would not exceed $1,000 annually. When it is considered that the daily loss in "unnecessary" stops of freight trains over such a road amounts to more than $200, the great saving resulting from the use of the wireless despatching system is obvious, actually amounting to considerably more than $70,000 yearly.

There are, of course, certain drawbacks to the extensive application of wireless telephony to passenger and freight trains. But these will be removed as soon as the natural structural difficulties are thoroughly mastered. As a commercial enterprise, wireless telephony has always toiled under an unlucky star. It was exploited before it was

ready—an inevitably disastrous step for a new science. There is no reason now, however, why the wireless telephone in its perfected state should not receive the recognition it so fully deserves, and take its place in the commercial world.

VEHICLE THAT TEACHES INVALIDS TO WALK

In the treatment of many invalids it is necessary to re-teach them to walk. This is notably true in cases of broken limbs, paralysis, locomotor ataxia and other similar maladies.

A device to aid the patient in learning to walk again has been devised and is in successful use in a Michigan sanitarium. It is called the walking chair, and by making use of the vehicle, the patient may first learn to use his feet while in a sitting posture. Later, when his strength is equal to the task, he can stand, supporting himself on the bars of the carriage. The wheels are rubber tired and the whole carriage is very light, though strong, offering practically no resistance to the motive power furnished by the invalid.

This Vehicle, Known as the "Walking Chair," has been Found Very Useful in Enabling Patients to Regain the Use of Their Legs.

The walking chair is especially valuable in the treatment of improving cases of locomotor ataxia, in which disease it is very difficult for the patient to recover the use of his limbs without an artificial support of some kind. This machine is used so frequently in cases of this kind that it is sometimes referred to as the "locomotor ataxi-cab."

If you enjoy THE WORLD'S ADVANCE, tell others; if not, tell us. Have you any suggestions? If so, why not write and state what they are?

FULMINATING MERCURY AND ITS USE IN WARFARE

One substance that is helping to fight the great European war is not getting the credit it merits. And that substance is fulminating mercury. It forms the cartridge caps that explode all the small arms ammunition, and it detonates all the mines and torpedoes, as well as the shells that explode on contact.

The fulminates are queer substances, and all of them are formed by the action of nitric acid on a metal, in the presence of alcohol. All fulminates explode on lesser provocation than any other solid bodies. The mercury fulminate, especially if mixed with powdered glass, explodes on being pounded or rubbed. Silver fulminate will blow up when touched with a feather. Mercury fulminate is, on the whole, the safest, but at that it will explode from no apparent cause.

RADIO-ACTIVE POTASSIUM

The experiments of Elster and Geitel, supported by those of MacLennan, Henriot and others, appear to show that potassium belongs to the list of substances possessing the property of radio-activity. It has been found that salts of potassium, obtained from the mines of Strassfurt, spontaneously give out an emanation which ionizes the surrounding air.

ELECTRIC GEMS SPARKLE FROM EXPOSITION TOWER

A tower of sparkling gems of various colors is the dazzling sight which greets the visitor to the Panama-Pacific Exposition grounds after nightfall. The tower is built in the shape of a pyramid, rising to a height of 433 feet. From top to bottom, jewels of every conceivable hue are suspended in various color groupings; altogether there are more than 125,000. They are made of colored glass and were cut and polished by Austrian lapidaries.

Each jewel is set in a large metal ring suspended from a hook. The gems are free to swing in the wind, so that when the light from fifty huge searchlights is played on them, they blaze with a constantly changing brilliancy. At the apex of each jewel a small mirror is suspended, greatly intensifying the refractive power of the facets. Both the jewel and the mirror are held to a bracket through a loop joint; the bracket being firmly held to the concrete wall by means of an expansion bolt, as shown in the sketch.

Views of the Tower of Jewels at the Panama-Pacific Exposition, Depicting the Arrangement of the Glass Jewels.

TWO NEW TUNNELS SHORTEN RAILROAD ROUTE

No longer will overland Southern Pacific trains crossing the Sierras be compelled to take the dizzy curve on the precipice above the American river known as "Cape Horn." Two tunnels have just been completed by the company at Wirts station through which all the transcontinental traffic will be deflected, thus doing away with the circuitous and somewhat hazardous route.

Trainmen have named these tunnels the "Panama Canal" for the reason that they have rendered unnecessary the journey around the "Horn."

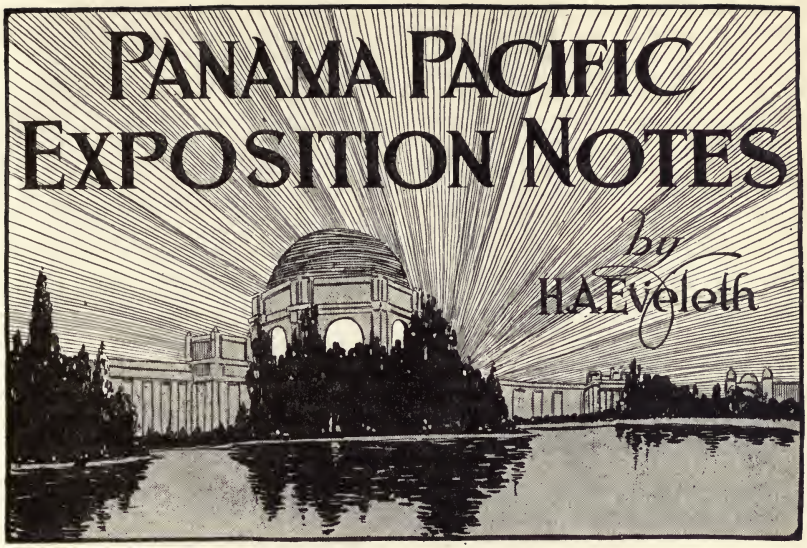
KNOWLEDGE OF THE SOIL

An expert of the Department of Agriculture at Washington avers that there are lands in the Old World, particularly in Europe, where the soil is platted and analyzed to the last square meter. This meter is worth so much; that meter is worth so much more; the grapes from that little patch are reserved for certain "cabinet" wines; the grapes from this patch are less valuable. In this relation special reference is made to the Schloss Johannisberger vineyards in Germany.

In China, too, there is found this exact knowledge of the value of every foot of soil; but in the Orient the knowledge came by tradition and custom rather than by laboratory analysis, as is the case in Germany.

In the United States the work of platting soil has only just begun, and the unit of measurement is much more likely to be an acre or a ten-acre field than a square yard.

All this furnishes a good reason why the crops of Europe are superior to those of our own country. Their land is no better than ours, says the expert quoted, but they know it better.



THE daily demonstration of mine rescue work given by the U. S. Bureau of Mines in the Mining Palace is attracting a great deal of attention. It is so realistic that the greater number of the spectators believe it to be a real calamity, and act accordingly. The visitor is suddenly startled by two terrific explosions, followed by an outpouring of dense smoke from one of the mine shafts located in the building. In a few seconds the mine rescue car speeds up to the door, four men clad in mine rescue suits and carrying a stretcher jump out, run through the crowd of questioning spectators and enter the smoke-filled shaft to rescue the dead and dying. In a few minutes they reappear carrying an unconscious man on the stretcher. They doff their cumbersome suits and headgear and set to work to administer first-aid treatment to the victim. Artificial respiration is given in the manner approved by the Bureau of Mines and employs no mechanical devices nor the complicated system usually practiced. The victim is placed on the floor, stomach downward, and pressure applied by one man to the lower ribs at the rate of sixteen times per minute. The pressure forces the air out of the victim's lungs, while the action of the muscles sucks it in again. Upon signs of consciousness his body is vigorously rubbed *towards* the heart. The next step is to ascertain the presence of other injuries and apply first aid. Our unfortunate miner is found to have a compound fracture of the left leg and an injury to his head, said injury being designated by a dab of red paint. The first-aid box—one of many placed in various parts of the mine—is resorted to; a tourniquet is applied to the leg to stop the arterial bleeding and the leg is put in splints. Next, the head is bandaged, and here it is noted that the wound is not cleansed, for it would be dangerous to do so with the impure water at hand. The injured man is now carefully placed on the stretcher and carried to the hospital maintained by the Bureau of Health, near the entrance to the mine, where the necessary surgical operations are performed. This over, the public is invited to go below and inspect the model coal mine, complete in all details, which has been sunk beneath the floor of the building.

The exhibit of the DeForest Radio

Telephone & Telegraph Company in the Palace of Liberal Arts is of considerable merit. A complete line of Audion and Ultraudion detectors, together with Audion amplifiers and radio-telephone apparatus, is on display. Among the last named is a 2-kw. 3,000-cycle generator for radio-telephony and a radio-telephone transmitter and receiver wall set of the type used by the Lackawanna Railroad. A wire of stranded phosphor-bronze strung to the top of the 435-foot Tower of Jewels serves as an aerial for the elaborate receiving set which is installed in the DeForest booth. Here will be seen the "DeForest Navy Receiving Tuner and Ultraudion Detector," which, together with the "Two-Step Amplifier," probably represents the latest development in the art of radio-telegraphy. With this combination the noon signals from Arlington, Va., ring a bell at the exhibit. It is claimed that the stations at Hamburg and Nauen have been picked up.

A well-known automobile manufacturing concern maintains a novel exhibit in the Palace of Transportation. The complete assemblage of an automobile from the bare frame to the finished product is shown in less than an hour's time. Six steps are required to do this, and the rapidity with which it is done is due to the efficiency and team work of the men employed in each step. As the machine is gradually assembled it travels very slowly along a track in order that it may be in place for the next series of operations at the finish of the preceding series. In this manner it is passed from hand to hand, so to speak, and no time is lost by slackness of the workmen. Four to six men are employed at each step, and as each gang is constantly at work the machines are turned out at the rate of six an hour. In the first step the front and rear axles and framework are assembled. In the second the engine, dashboard, tank, steering and driving gear are installed. In the third the radiator, mud guards and running boards are bolted to the chassis. In the fourth the body is lowered into place, the windshield bolted to the dashboard and the wheels and tires are put on. In the fifth the engine is wired up and the horn, lamps and other accessories are installed. In the sixth the tank is filled with gasoline, the machine tested by bringing its rear wheels into contact with a motor-driven revolving cylinder, then the throttle is manipulated and the finished automobile travels to the shipping department under its own power.

An exhibit of special interest to the hydraulic engineer is that of the Pelton Water Wheel Company in the Palace of Machinery. The principal machine is a 20,000 h.p. Pelton-Doble single-discharge hydraulic turbine with overhung runner, which has been built for the 1916 installation of the Pacific Gas and Electric Company at Plant 5 of the Lake Spaulding development. It has a weight of 186,000 pounds, while the head is 500 feet, and the speed is 360 r.p.m. The exhibit also includes a 10,000 h.p. Pelton-Doble water wheel with interlocking buckets. The total weight is 12,000 pounds with a head of 1,350 feet and a speed of 360 r.p.m.

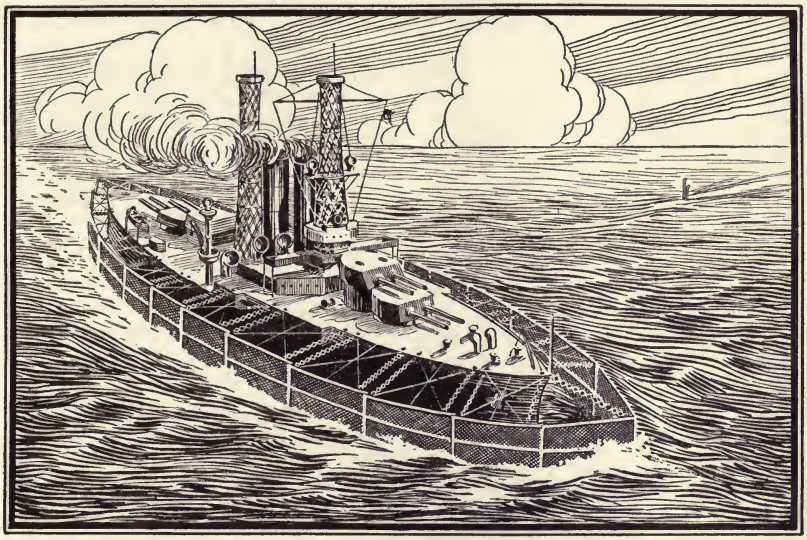
NEW USES OF TUNGSTEN

Tungsten is finding an ever-increasing use in electrical work aside from its application in incandescent lamp filaments. In certain of the newer Crookes, or X-ray tubes, which are designed to work at high intensities, being capable of absorbing 10 kilowatts and taking pictures through even the thickest parts of the human body, tungsten has been used as the anode target for the cathode rays, the rare metal being backed with copper to convey away the heat developed. Although rendered molten by this instantaneous impact of electrons, the great surface tension of the tungsten prevents loss or change of shape. Tungsten electrodes have also been used for gas engine spark-gaps, and show longer life than those of other metals of equivalent cost.

This is your magazine. It is edited to please you. Are we succeeding? Have you any suggestions to make?

NEW DEVICE PROTECTS VESSELS FROM MINES AND TORPEDOES

GRIM evidence of the effectiveness of the submarine mine and the torpedo has been given in plenty in the European war and it is but natural that the minds of inventors should turn toward the development of devices which shall protect vessels at sea from the danger of contact with submarine explosives.

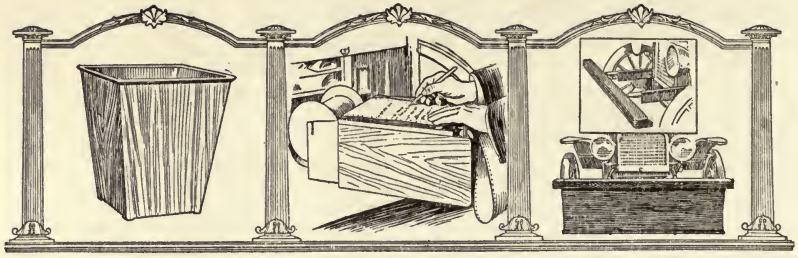


A Dreadnought Protected Against Torpedo Attack by Means of Screen Shutters which are so Designed as to Offer the Minimum Resistance to the Forward Movement of the Vessel.

While the torpedo net has been known and used for years, its efficacy has long been a matter of conjecture and possibly of doubt, for the modern automobile torpedo can be so arranged as to cut its way through the heavy steel netting, thus nullifying the protective value of the torpedo net.

Now comes an inventor with a device which looks ingenious in the patent drawings and which may prove at least a partial solution of the problem. The equipment consists essentially of a series of shutters of rugged construction and so arranged that they may be held suspended from the sides of a vessel and reach down into the water to a depth greater than the ship's draft. The intention is to suspend these shutters on all sides of the craft in order that the torpedo or mine may strike the shutter and explode before it comes into contact with the side of the vessel. The idea is that the explosion at a distance of a few feet from the ship would be comparatively harmless.

The protective shutters are to be arranged in such a manner that they will fold up and in close to the sides of the ship when not in use. The apparatus intended to perform this feat is in the nature of a pair of lazy tongs at each end of a section of shutter. This device, in connection with a suitable arrangement of cables and pulleys, is supposed to raise and lower the shutters as well as control the distance between them and the vessel.



A Metal Basket. A Machine that Remembers. An Automatic Fender.

Recent and Improved Devices

Metal Basket Resembles Wood

A metal waste basket, finished to resemble wood so perfectly that it is almost impossible to detect the difference, is being manufactured in Syracuse, N. Y. No screws or rivets are used in its construction. The bottom can be pressed in, the top rim removed and the sides collapsed, so that the basket can be shipped in a flat bundle. The baskets are finished in mahogany, oak and olive.

A Machine That Remembers

A machine which will remember the date and hour of an appointment made several weeks previous is one of the latest efficiency devices to be placed on the market. A roll of paper strip passes over a flat surface where the appointment is indicated and a punch mark made in the margin. When that time occurs a gong is sounded and a reference to the strip will give the information as to what appointment is to be kept.

A Telescopic Fender

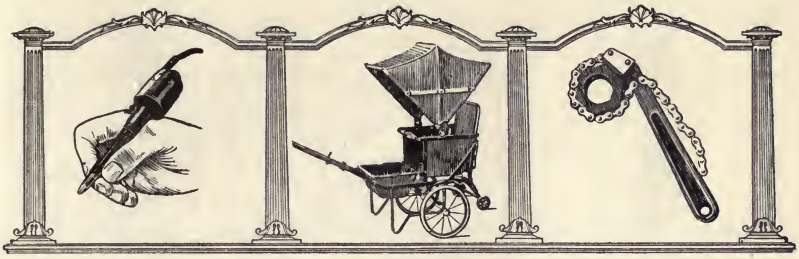
A telescopic fender for automobiles which recently won third place at the New York Invention Show is shown in one of the drawings. The instant a body touches the bumper a curtain drops in front so that it is impossible for the body to be crushed or injured by the wheels. This device, when struck, automatically shuts off the magneto so that the car comes to a standstill.

Further Details Concerning the Phonoscope

In the April issue of THE WORLD'S ADVANCE there appeared a short article telling of the newly invented "phonoscope"—an instrument for rendering sounds of speech and music recognizable to the eye. Additional details have recently been secured through the kindness of Mr. S. B. Banerjea of Calcutta, India.

The phonoscope is the invention of Dr. Fournier Dalbe, professor of science at the Government College, Lahore (Punjab), India. It consists essentially of a sensitive monometric flame of acetylene gas, mounted close to a brass disc in which are bored a number of holes arranged in concentric circles. A small electric motor rotates the disc at a constant speed. When sounds are spoken or sung into a small trumpet attached to the instrument, the revolving disc appears to break up into a number of patterns that vary instantaneously with the variation of the sound, however slight. By means of the phonoscope,

Space does not permit these interesting devices to be described at greater length. However, any reader desiring more detailed information concerning devices described in these columns can secure it upon request.



Electric Motor for Dentists. Go-Cart with Curbstone Wheels. A Novel Wrench.

persons who are totally deaf are able to observe the sounds of speech and music by means of the eye. The phonoscope may be considered to be a companion instrument to the optophone; the latter enabling blind persons to read by means of the ear. Dr. Dalbe's invention is very recent and it is said that only his students and a few fortunate outsiders have been permitted to see it. It is expected that he will shortly exhibit it to the public.

Tiny Motor for Dentists' Use

A motor which is said to be the smallest one in the world used for commercial purposes is employed by dentists for drilling operations on the teeth. A marked advantage of this little motor, which makes it peculiarly valuable to the dentist, is its unobtrusiveness, in decided contrast to the usual formidable dental engine which frightens the nervous patient and creates the fear of painful grinding and drilling. The weight of the motor is only five and one-quarter ounces. It consumes 12 watts and runs at a normal speed of 1,500 revolutions per minute.

Curbstone Wheels on Go-Cart.

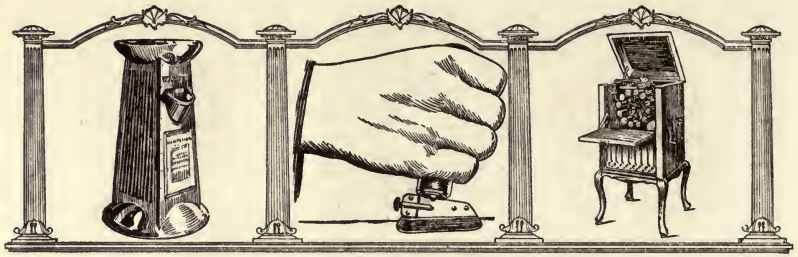
An Ohio inventor has devised a go-cart with small wheels in the rear by means of which it may be pulled up over the edge of curbstones without jarring the child. The curbstone wheels are small, supplemental wheels that project back of the carriage, and ordinarily do not extend much more than half way to the ground, but which assist in lowering or raising the main wheels over curbstones and steps. The go-cart may be folded up when not in use, so as to take up but little room.

A Novel Wrench

A wrench which is adapted to fit hexagonal nuts of any size has recently been put on the market. Adjustment is made by a notch in the handle, into which fit the links of a chain. The chain is wrapped around the nut, pipe or part to be gripped, tightened and slipped into the notch. A pull of the handle in the proper direction will cause the jaw to tighten and grip the object in a vise-like hold. The wrench is either right or left handed.

The Specific Gravity Balance

In the ordinary specific gravity balance the substance under investigation is weighed in water, and from the weight of the water displaced the specific gravity of the substance is calculated. There has been devised by Professor A. F. Rogers of Stanford University a balance which does away with the necessity of a calculation. The specific gravity of the substance weighed is read directly from a graduation on the beam of the balance. In practice, with specimens of mineral weighing only two or three grams, the indications have been found accurate to



A Sanitary Cuspidor. A Box-Opening Knife. Phonograph of New Design

about two units in the second decimal place.

A Sanitary Cuspidor

A neatly finished brass and aluminum receiver, intended to be used in place of the unsightly cuspidors and waste baskets commonly seen, has been devised for service in hotels, depots and other public buildings. A bowl is placed at the top, while chutes open at the sides for waste paper, pealings and other rubbish. The bowl is fitted with a brass rim which contains a perforated pipe connecting with the water system, so that the bowl is rinsed continually.

A Box-Opening Knife

An ingenious knife for opening pasteboard boxes and sealed cartons without danger of cutting ones fingers or projecting the knife into the contents of the box has been invented in Connecticut. The knife is a short blade projecting centrally from an angular shoe, the sides of which are placed at right angles to each other in order to form a channel that runs smoothly along the edge of the box while the blade slits its edge. The blade is adjustable in order to regulate the depth of the cut. Different sizes of cutter blades are contained within the handle.

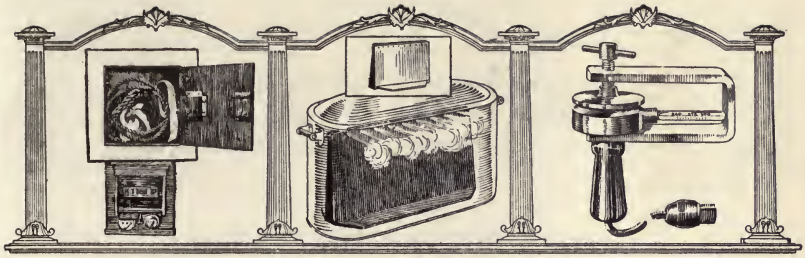
THE WORLD'S ADVANCE is your magazine—edited especially to meet your desires and pet hobbies. Is there anything you have in mind which would improve it?

Phonograph Plays Continuously

A phonograph which will play twelve different records in succession by an arrangement of automatic mechanism has recently been put on the market. The records are of the cylindrical type and are attached to twelve arms which radiate from a central shaft. The motor is wound, a button is pressed and the twelve records play automatically. The makers of the "Autophone," as it is called, claim a minimum of sound distortion—that the resultant music faithfully reproduces the original.

The British Radium Safe

Radium being incomparably more costly than gold—its price being quoted at more than $3,000,000 an ounce, although no one is prepared to furnish so great a quantity of it—naturally has to be carefully guarded, and a special safe for this most precious of metals was some time ago constructed for the British Radium Corporation. The safe-maker had to "face his defenses both ways." To defy burglars' tools he had to have walls of steel, and to keep the radium emanations from escaping he had to construct an interior cage of lead—lead being practically the only metal not penetrable by the rays. Another difficulty to be overcome was the construction of a door that would prevent the loss of emanations when it was opened. Valves are fixed in the door, through which tubes of mercury can be passed for the collection and storage of the emanations.



A Combination Fire Alarm. Wash Boiler Attachment. A Low-Voltage Vulcanizer.

A Combination Fire Alarm Box

A departure from the ordinary types of fire alarm boxes is shown in one of the illustrations on this page. Breaking the glass in its cover will not only permit the alarm being registered at some centrally located point, but upon opening the door a rope and harness are found which are to be used in escaping from the burning building.

Makes Washing Machine of Wash Boiler

The cumbersome mechanism of the usual rather costly washing machine is entirely done away with in a simple device which may be attached to a wash boiler. It consists of a wedge-shaped metal box, flared at the bottom and punched with a number of small holes at the top. Water is heated in the bottom of the wedge, so that the steam generated forces twenty streams of boiling suds into the clothes, thoroughly cleansing them.

A Low-Voltage Vulcanizer

A new vulcanizer, which is compact and well made, will operate on a six-volt storage battery. The total weight, including the carrying case, is about two pounds. A thermometer is attached to the base in which the heating coil is placed, its use there being to regulate the heat, which under ordinary conditions should be maintained at 275 degrees.

Demand for Alligator Skins and Oil

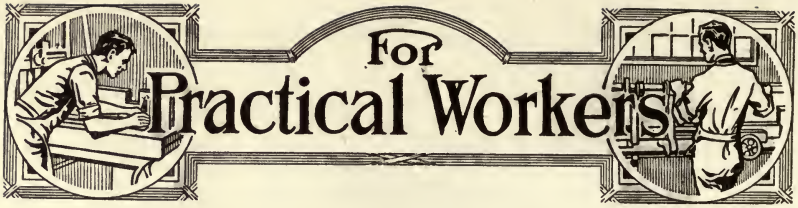
For a long time the demand for alligator skins has been so great that the manufacture of serviceable imitations has attained a point where even experts are sometimes deceived. At least such is claimed to be the case in Europe, where "alligator" skins that grew on the backs of sheep are passed for the genuine article. In order to increase the supply of the real skins, the possibility has been considered of raising alligators in certain of the French possessions.

Alligator oil or grease is also in great demand, especially by the manufacturers of articles made from chamois leather.

Submerged Firing

The Brünler system of submerged firing constitutes a remarkable method of producing steam. The usual method —that is, conveying the heat to the water through the walls of the boiler—is wasteful both of heat and of material. In the Brünler system, a high-pressure gas jet is ignited under the surface of the water in a steam generator of cast steel, and a cast-iron boiler receives the liquid, the steam, and the gaseous products of combustion. The fuel is coal-tar oil. It is said that a firm of chemical manufacturers in Germany has used a Brünler boiler with great success.

If you enjoy THE WORLD'S ADVANCE, tell others; if not, tell us. Why not hand this copy to a friend after you have read it through?



A PORTABLE PRINTING CABINET

By Robert C. Schimmel

Ordinarily the photographic amateur has little available working space. The basement is usually very damp in the summer and the attic very cold in the winter. A portable printing and developing cabinet, accordingly, will be of interest to the average amateur.

The cost of building a cabinet depends, of course, on the amount of material that the maker has on hand. A list is given below of the materials that will be required.

FOR THE FRAME.

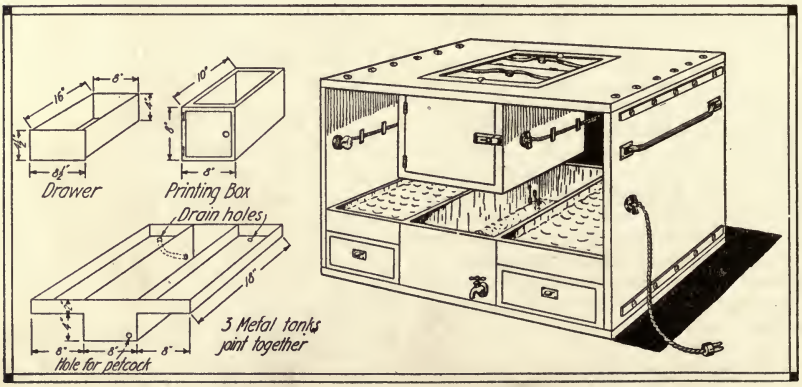
Six 2 ft. poplar 9″ x ½″.
Four 18″ poplar 9″ x ½″.

FOR THE DRAWERS.

Two 8½″ poplar 4½″ x ½″.
Four 16″ poplar 3½″ x ½″.
Two 16″ poplar 8″ x ½″.
Two 7″ poplar 3½″ x ½″.
Two 6″ lengths ¼″ lead pipe.
Two snap switches.
Ten feet lamp cord.
One plug.
Two small corks.
One small pet cock for water tank.
Two small hinges for printing cabinet door.
One box of one-inch *brass* flat-headed screws.

METAL WORK.

Two 18″ x 6″ galvanized iron. (Medium weight.)



Two 8″ x 6″ galvanized iron. (Medium weight.)
Four 8″ x 2″ galvanized iron. (Medium weight.)
Two 18″ x 2″ galvanized iron. (Medium weight.)
One 8″ x 10″ printing frame.
Four wall sockets.
Two carrying grips.

The material for the printing box depends solely on what sized pictures the maker wants

to print. The dimensions given are for an eight by ten printing frame.

PRINTING BOX

Two 8″ x 8″ x ½″ poplar.
Two 8″ x 10″ x ½″ poplar.
One 9″ x 11″ x ½″ poplar.

FOR JOINING FRAME.

Four 2″ x 18″ x ½″ poplar.

The first part of the cabinet to make is the frame. The completed casing will measure 24 x 18 x 18 inches. Back boards should be cut to cover the joints made by the other boards. The whole should be put together with brass screws, as they do not rust when the wood becomes damp. It is difficult to prevent the wood from warping, for a certain amount of the water in the different steps in developing is certain to be splashed upon it.

The box for the printing frame should be assembled from the four pieces named for the purpose. The printing frame itself should be of the 8 x 10 size. Two small blocks of wood should be nailed a short distance down the side of the box in order to hold the frame in place. Two tungsten lamps will be necessary to print the pictures, and a small 4 c.p. red light should be installed as a pilot for the operator in making true and even prints. The arrangement for these lights is shown in the diagram. The red light may be connected to burn continuously; the white lights should be controlled by a switch.

The most difficult part of the task in building the cabinet will be encountered when the metal work is taken up. Unless the builder has had considerable experience along those lines, it is best to give the making of the tanks to a competent plumber. The water tank is the largest of the three and should be made first. The hypo and developing tanks should be of the same size. A quarter-inch hole should be cut in one of the corners of each of the smaller tanks and several feet of lead pipe soldered to them. A stop cock should be soldered over a hole cut in the front of the water tank.

Into the space under each of the smaller tanks, drawers should be fitted. These may be used for storing paper of various grades, negative albums and chemicals.

In wiring the cabinet, a wall socket should be placed above the developing tank for the red lamp. This socket should be provided with a snap switch.

The printing box should be placed under a hole cut in the top of the cabinet and the cracks puttied to prevent light leakage.

Carrying handles should be fastened at each end of the cabinet and the woodwork coated inside and out with gloss enamel.

Head Band for Jewelers' Glass

A head band to obviate the uncomfortable procedure of squinting the eye to hold a jewelers' glass in place can be made from a length of watch main-

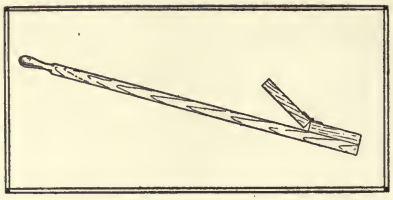
spring. One end of the spring should be riveted. When the glass is not in use it can be pushed up out of the way on the forehead.

Contributed by

JAMES MCINTYRE.

A Home-Made Jack

A home-made jack which may be used for light work is shown in one of the drawings on this page. It consists of a



sound 2x4 scantling about 5 ft. long to the lower end of which a 10″ strip is bolted. A ten or twelve-inch length of the same material should be hinged to the upper end of this block and the opposite end of the scantling whittled off to form a handle.

Contributed by

GLENN G. FOGLESONG.

An Aluminum Moving Picture Screen

A brilliant, aluminum screen for moving picture houses can be made quite easily and the results will be practically as satisfactory as if a high-priced manufactured screen were used.

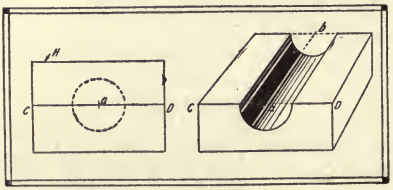
If the screen is to be made on a plaster wall, a coat of white calcimine should be applied and allowed to dry for twenty-four hours. Upon this, one coat of glue size should be applied and allowed to dry from five to eight hours until it becomes tacky—not sticky, but still not quite dry. Aluminum powder should be brushed rapidly over the glue surface with a soft flannel cloth. Afterwards, the surface should be smoothed over with silk or soft flannel.

Contributed by

C. W. SMALLEY.

To Cut Half Circle Across Timber Face

A semi-circle can be cut across the face of timber in the following manner. A line, *A B*, which will be the center of the half circle desired, should be drawn. This line should be cut to a depth of 1/16″ with a fine saw. A block, *H*, should be placed on block *C D* and the pieces clamped together. The hole should be started with an expansion bit at *A*. The spur will follow the saw cut.

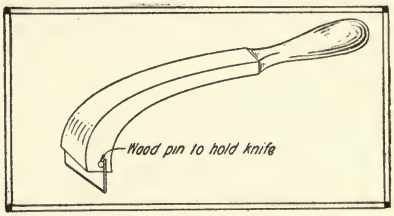


Contributed by

M. D. CROSS.

A Hard Wood Floor Scraper

A scraper for hard wood floors can be made by fashioning a heavy wooden handle and cutting a slot into its lower end in order to insert a blade of some sort. The blade should be held in place by a wooden pin. A sharpened fragment of an old saw will serve for the scraping edge.

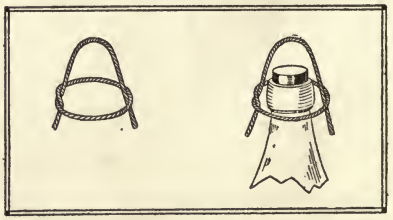


Contributed by

L. M. NIXON.

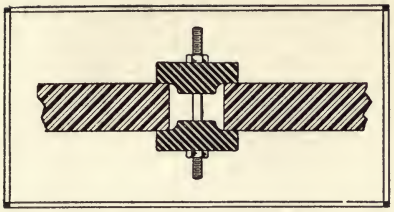
To Tie a Cork in a Bottle

A cork may be held securely in a bottle if a knot is tied about it and the neck of the bottle, as shown in the accompanying drawing. The ends of the string or cord should be drawn up and tied upon the top of the cork.



Contributed by

GLENN G. FOGLESONG.



Insulating a Lead through a Switchboard

A lead through a switchboard panel can be well insulated by boring a hole in the switchboard large enough to accommodate the projections of porcelain clamp tops and bolting these together by means of a threaded brass rod. The threaded ends which project should be of sufficient length for making connections to the bus bars or wires.

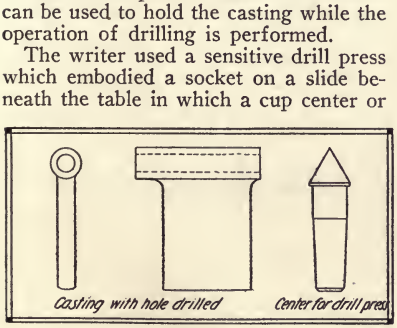
Contributed by

FRANK HARAZIN.

To Make and Use a Center in the Drill Press

Castings of the form shown in the accompanying drawing can be machined in an ordinary drill press if the directions given below are followed. Each end of the part to be bored should be center-punched and the hole drilled from one end to within ⅛ in. of the other end. The holes should be finished by placing the casting on a board, running the drill through—the drill being guided by the length of the hole already drilled—so that the holes come straight with respect to the centre punch marks. A wrench can be used to hold the casting while the operation of drilling is performed.

The writer used a sensitive drill press which embodied a socket on a slide beneath the table in which a cup center or "V" center was held. A taper was turned to fit into the headstock of the lathe. It was then put between centers and turned so as to fit snugly in the drill press socket. This socket had parallel sides. In turning the taper to fit the drill press, part was cut away, but enough was left so that the 60° angle easily turned, the center being held in the head-stock.

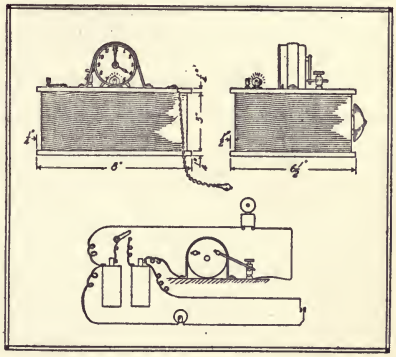


Contributed by

CLARENCE H. ANDERSON.

An Electric Alarm Clock

For the construction of an electric alarm clock shown in the accompanying drawings the following material will be required:



For the mechanism:

Four dry cells, one door bell, one one-point switch, one 2½-volt lamp, 20 ft. soft braided covered wire, one rosette push button, one miniature socket, one binding post, one alarm clock, one brass strip, and two bolts to fasten band to box for holding clock down.

For the box:

Two pieces 6½ in. x 8 in. (for the top and bottom); two pieces 7½ in. x 3 in. (for the sides); two pieces 5½ in. x 3 in. (for the end pieces).

The sections of which the box is made should be beveled at the top and bottom. The switch, socket and binding post should be fastened upon the top board, together with the clock, which is secured by means of the brass strip and two screws or bolts. A short length of wire should be passed through the hole in the

binding post parallel to the side of the box, as indicated in the drawing. A wire should be soldered to the alarm winding key of a sufficient length so that it will rest upon the wire which passes through the binding post when the alarm goes off. This completes the circuit and causes the electric bell on the back of the clock to ring until the switch is turned off.

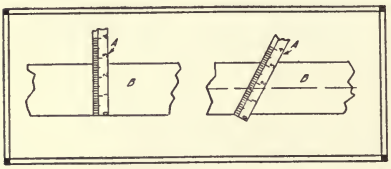
In a dark room, the time may be found by pressing the button of the rosette and lighting the bulb, which illuminates the dial.

Contributed by

LOUIS WOLDMAN.

Finding Centers of Boards

The center of a board of uneven width may be found quite easily by placing the end of a ruler at one edge and swinging it until one of the inch marks is opposite the other edge. This number should



be divided in half. The dividend, when found on the rule, will mark the center of the board exactly.

Contributed by

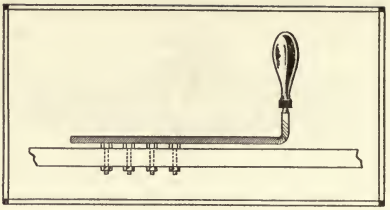
DELBURT SAGE.

Repairing Rubber Boots

A cracked rubber boot can be repaired much in the same manner as is followed in mending inner tubes. The surface about the crack should first be sandpapered and cleaned with gasoline. A section of inner tube vulcanizing gum about ½ inch larger than the hole should be cut and cleaned with gasoline after the cloth covering is removed. It should be held in place over the hole and vulcanized in the usual way.

Contributed by

CLARENCE O. WHEELER.



A Handy File

Difficulty to an exasperating degree is usually encountered when an attempt is made to file projecting bolt heads, switch points or nail points with an ordinary file. To prevent the difficulty, the file should be softened at a point near the handle in the flame of a torch, and bent to form a sharp right angle.

Contributed by

FRANK HARAZIN.

To Remove White Spots From Varnish

If a cloth of soft texture is rubbed briskly enough over a milky spot on varnish the heat generated by the friction will heat the varnish and cause the spot to vanish.

Contributed by

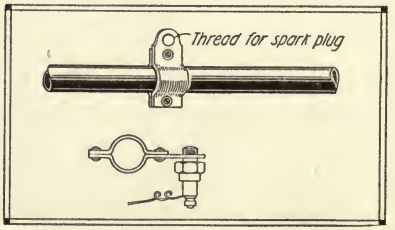
A. STANLEY WIENOLD.

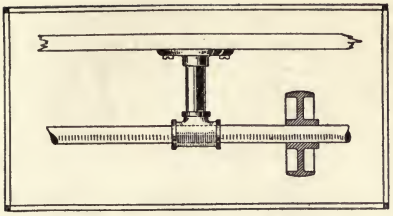
Spark Plug Testing Rest

Instead of following the usual inconvenient procedure in testing motorcycle spark plugs of holding them in the hand or laying them on the frame, a small clamp, with a projecting flange bored to contain the spark plug screw, may be fastened to one of the pipes of the engine.

Contributed by

A. ANDERSON.





Shaft Hanger for Pipe Fittings

A good pipe hanger can be made from pipe fittings. The pipe through which the shaft runs should be babbitted and reamed to size, and the other parts fitted, as shown in the drawing. Two oil holes should be bored in the top of the bearing pipe, and, if desired, an oil groove cut in the babbitt metal.

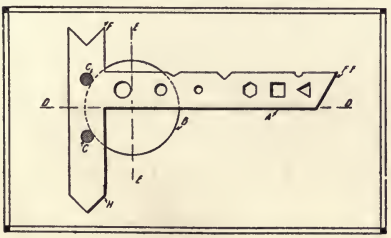
Contributed by

R. E. Nelson.

Combination Center Square

A center square for locating the center of round stock can be made from a plate of sheet steel cut to shape shown in the drawing. It should be ⅛" thick, and cut to form a perfect right angle. Two stationary pins, *C C*, should be cut from ¼" iron rod and riveted to the head of the square, *A*. The ends of the square, *H* and *F*, are used for center gauging; the end *D* is used as a miter. The square, *A*, should be provided with three holes for drill gauges, one of them six-sided or hexoganal; another square, and the remaining one triangular. Notches should be cut in the side of the square for thread tool gauges.

The method of using the tool in marking round stock is as follows: Lines should be scratched across the end of the stock from *D* to *D*, then from *E* to *E*. The intersection of these lines makes the center desired.



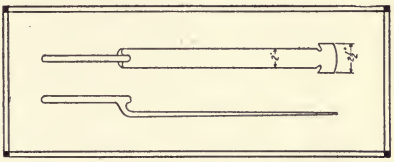
Contributed by

Arthur L. Kerbaugh

Chisel for Shingling

A shingle chisel can be made from the blade of a steel square with the cutting end drawn out ⅜ in. and a slot filed, as shown in the accompanying sketch. The handle should be fashioned from ⅝ in. steel stock and welded to the blade so that an offset of about ¾ in. results. The cutting end should be tempered hard enough to cut off nails.

The object of the handle offset is that



it may be raised above the butts of the shingles, so that the chisel may be driven out easily, and if the hook is over a nail, it will pull it out.

This tool will not split the old shingles in removing them and it will extract all of the old nails without disturbing the other shingles.

Contributed by

Wm. Albin.

New Idea for File Handles

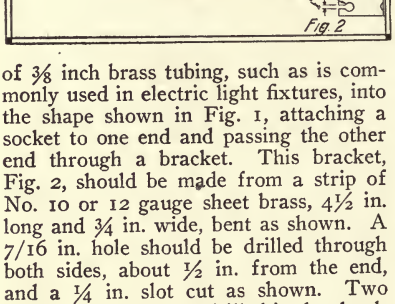
Handles for small files and chisels can be made from the wooden part of the ordinary bundle carrier. After the wire is removed and the hole plugged, the tang of an old file should be heated red and a hole burned in the end of the handle to a depth not quite that desired for the tang. The tang should then be driven in tightly. The fact that the hole has been previously burnt will prevent the handle from splitting. Handles for larger files can be made by the same method from the handles of old pails and tubs.

Contributed by

Clarence H. Anderson.

Adjustable Lamp Bracket

An adjustable lamp bracket which will be suitable for the workshop or laboratory can be made by bending a length



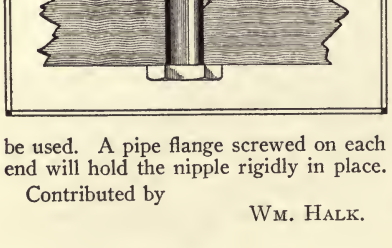
of ⅜ inch brass tubing, such as is commonly used in electric light fixtures, into the shape shown in Fig. 1, attaching a socket to one end and passing the other end through a bracket. This bracket, Fig. 2, should be made from a strip of No. 10 or 12 gauge sheet brass, 4½ in. long and ¾ in. wide, bent as shown. A 7/16 in. hole should be drilled through both sides, about ½ in. from the end, and a ¼ in. slot cut as shown. Two small holes should be drilled in the shoulders for mounting purposes. To complete the lamp, the wires are to be inserted through the slot and the brass tubing placed in the bracket.

Contributed by

C. P. Cleary.

Metal Bushing for Wooden Pulleys

When it is desired to insert a metal bushing into a wooden pulley, lever or wheel, for the purpose of rotating it on a bolt, a pipe nipple with an inside diameter equal to the diameter of the bolt can



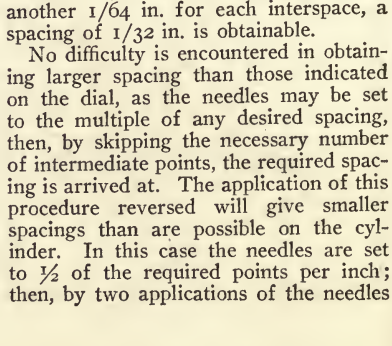
be used. A pipe flange screwed on each end will hold the nipple rigidly in place.

Contributed by

Wm. Halk.

Spacer for Use in Drafting

This spacer should be found quicker and more accurate for laying off rack teeth, bolt threads and similar measurements than ordinary dividers. Its use overcomes the trouble frequently experienced in spacing equidistant points along a line with dividers. It consists of a rectangular frame, *A*, in which is pivoted the groove cylinder, *B*. A beveled piece, *D*, is fastened to the lower bar of the frame by means of set screws, *E* and *F*. In the spaces between these two bars a number of cross-shaped prick needles are inserted. The unpointed ends of these needles should fit with surface contacts within grooves on the cylinder. The grooves converge from their widest spacing toward a common apex. Hence they are equidistant along all elements of the cylinder. By turning a thumb screw, *G*, the cylinder in revolving slides the prick points nearer or farther apart according



to the direction of the motion, right or left. An index plate, *H*, on the end of the cylinder, gives the spacing per inch. The smallest spacing to which the needles may be set is limited by the width of grooves and interspaces. Allowing a width of 1/64 in. for each groove and another 1/64 in. for each interspace, a spacing of 1/32 in. is obtainable.

No difficulty is encountered in obtaining larger spacing than those indicated on the dial, as the needles may be set to the multiple of any desired spacing, then, by skipping the necessary number of intermediate points, the required spacing is arrived at. The application of this procedure reversed will give smaller spacings than are possible on the cylinder. In this case the needles are set to ½ of the required points per inch; then, by two applications of the needles

to the line, the second being half the spacing of adjacent needles in advance of the first application, a very exact result is obtained.

Contributed by

DANIEL MOLONY.

To Drain a Boat—Bore a Hole in the Bottom!

During a race on the Allegheny recently one of the motor boats, a light racer, was found to have sprung a serious leak. It was not equipped with draining equipment or a power pump of any kind. The hand pump was insufficient. The engineer hurriedly bored a hole slanting astern in the bottom of the boat. No sooner was the bit drawn from the hole than the suction of the water rushing by beneath completely drained the boat. Then a wooden plug was inserted. During the remainder of the race this plug was removed at intervals and the boat was drained effectually each time.

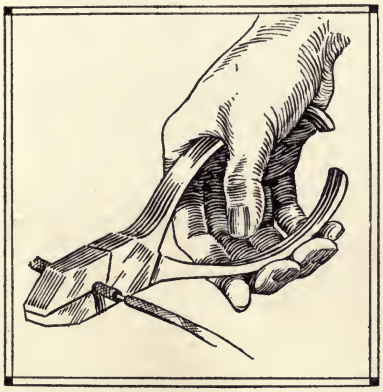
Contributed by

JOSEPH J. STEEDLE.

Wire Cutters to Remove Insulation

If a small hole is filed in the cutting edges of pliers, the insulation of wires can be easily cut without injuring the wire.

Contributed by L. L.



Hatpin Protector

A protector for hatpin points can be made from a tapering tube, sealed at the thick end and fitted with a light spiral spring running the entire length and forcing a ball bearing over the small opening. When the hatpin is inserted, the spring forcing against the ball will exert sufficient pressure against the shaft of the pin so that it can only be withdrawn with difficulty.

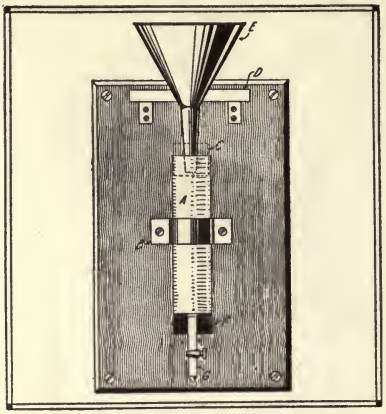
Contributed by

JAMES MCINTYRE.

To Purify Mercury

When mercury is used for experimental purposes it frequently becomes contaminated with other metals. For most purposes it is of the greatest importance that these impurities be removed. A simple plan for accomplishing this is to allow the mercury to pass through dilute nitric acid in a fine stream. The apparatus described here can be made quite easily and may be used any number of times. It may be made in a suitable size for the work required.

The accompanying drawing shows the various parts attached to a baseboard. Glass tube *A* is held in a vertical position by a brass saddle *B*. This tube should have a capacity several times greater than the volume of the mercury to be handled. The upper end should be closed by a removable cork *C*, to exclude dust



when not in use. A wooden bracket *D* should be attached to the baseboard above the tube for the purpose of supporting a glass funnel. The end of the stem of this funnel should be cut off square and held in the flame of a bunsen burner until the aperture is very small. The lower end of tube *A* should then be closed with an india rubber cork *F* very securely held in place. A glass tap fitted with a valve at its lower end should pass through the cork.

When this apparatus is to be used the cork *C* should be removed and the mercury to be purified poured into the tube. The tube should be filled to within an inch or two of the top with dilute nitric acid. Twenty or twenty-five per cent. acid is desirable. The mercury should be drawn from the tube by means of the tap *G* and poured into the funnel. From here it will flow in a fine stream through the acid and be thoroughly purged of all impurities. When the mercury has settled in the bottom of the tube it may be drawn off into a beaker from the tap. This cleansing process should be repeated several times in order that the acid may take full effect. Afterwards the mercury should be freed from the acid by washing with clear water. It may be dried by heating to a temperature of 212 degrees F.—the boiling point of water—in a non-metallic vessel.

Contributed by H. JOHN GRAY.

Another Furniture Polish

A few grains of butter of antimony added to a bottle of ordinary sewing machine oil makes an excellent brightener for old furniture or scarred varnished surfaces. It is easily made and one bottle will cover a great deal of surface. Apply sparingly and rub to a polish with a soft rag.

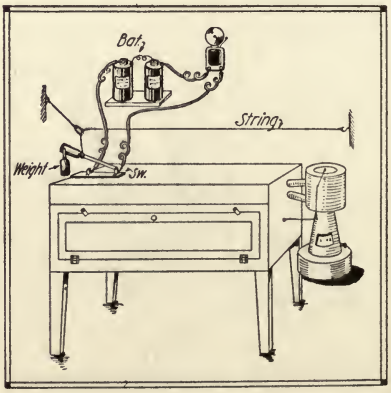
Contributed by
LOREN THOREAU WARD.

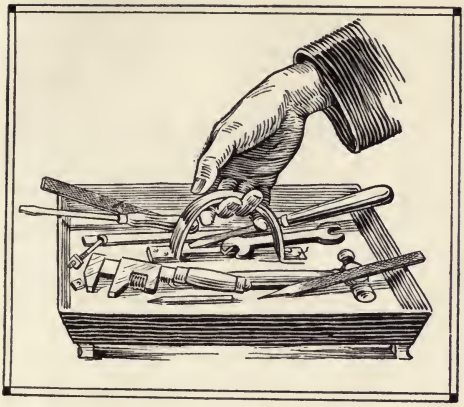
Fire Alarm for the Incubator

Incubators nowadays are built in a way that usually banishes the fire hazard. However, some danger of fire is always present in a gas or oil heated incubator. A suitable design for a fire alarm which will serve to call the owner should an incubator catch fire, is described in the following:

Fasten a long-bladed knife switch to the top of the incubator. The pivot of the switch should be adjusted until the blade works very easily. A light cord should be strung a few inches above the incubator and fastened to the wall by means of a screw-eye. The other end of the cord terminates at the handle of the switch. If the incubator should burn, the flames will ignite the string, the weight on the switch handle will cause the circuit to be closed, and the bell, which could be located in any part of the house, will ring the warning.

Contributed by F. E. POISTER.





Portable Tool Box for the Workshop

A portable work box for the shop can be made in the following manner. A board about ten inches wide should be dressed and a handle fastened exactly in the center. Sloping metal sides should be nailed to the edges of the board and soldered or welded along the seams. Small legs can be added, if desired, to support the box.

Contributed by

J. N. BAGLEY.

Hints for Erecting Fence Netting

When netting is unrolled it works into a circle for the reason that the wires passing through the inner edge are strained tighter than those passing through the outer edge. The result is that when the netting is straightened the upper edge is tight, while the lower edge is loose and bulging. This seemingly undesirable feature may be taken advantage of by putting up the netting with the loose edge along the ground, so that it will conform with the irregularities of the surface.

In some soils the netting rots rapidly. This can be overcome by tarring the bottom edge. Coal tar should be placed in a tub or similar vessel to a depth of seven or eight inches. The roll should be placed in this liquid, bottom down, for several minutes and then raised by a block and tackle and allowed to drain.

Staples mean the destruction of netting when stock push against it. At the straining post a wire should be passed in and out through the mesh and fastened to the post with nails.

The old method of unrolling a coil of netting was to draw it out over the ground. An improvement can be made by passing a bar through the roll, a man grasping each end and carrying the coil, which pays out freely.

Contributed by

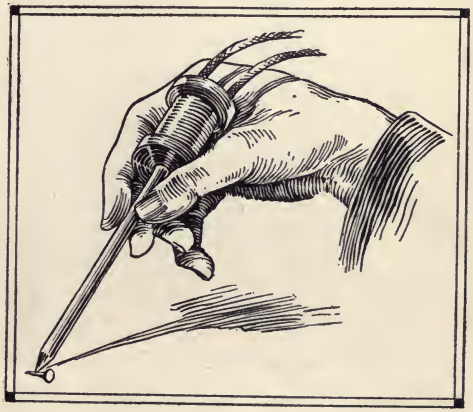
LEONARD KEENE HIRSHBERG.

Hand Magnet Picks Up Tacks

A hand magnet for picking up tacks and filings can be made from a steel spike and a bobbin of coarse magnet wire held in place at the head by insulating tape. One or two dry cells will provide the necessary current.

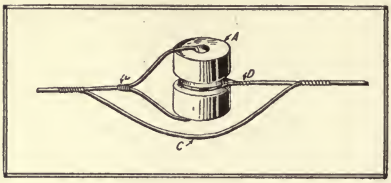
If the reader possesses a fair amount of ingenuity, he may arrange some sort of switch in the magnet circuit so that the hand will automatically turn on the current. This will save the battery.

Contributed by L. L.



Stops Hum of Telephone Wires

The unpleasant humming of telephone wires can be prevented by inserting a porcelain knob, *A*, in the circuit and



bridging the short length of wire, *C*, around it. The splices, *B* and *D*, should be carefully made and soldered.

Contributed by

B. SCHUMM.

To Lift Driving Wheels

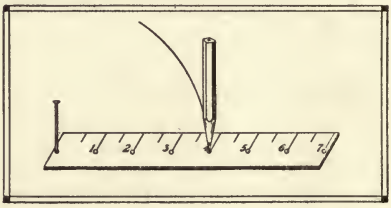
A device to lift heavy driving wheels in pairs from one part of the shop to another is illustrated herewith. The cross bar of the dimensions shown is far superior to the older method of using chains alone, as it relieves the shaft of all bending strain and the turned up ends of the bar eliminate all possibility of accident through the wheels slipping off the bar.

Contributed by

JOSEPH K. LONG.

Drawing Circles with a Ruler

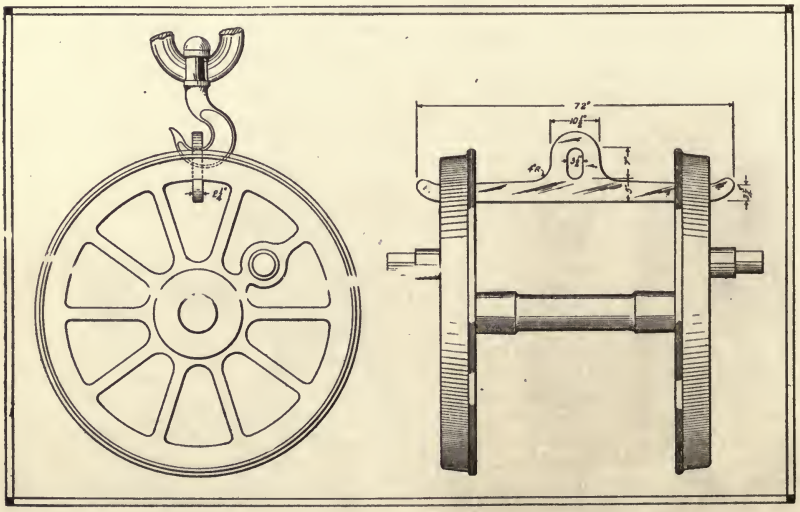
A small pocket rule may be used as a compass with the aid of a pencil and an ordinary pin. A small hole should be drilled near the end of the ruler just large enough to admit the pin. Holes as large as the point of a lead pencil should be drilled through the rule at various markings. By placing the pin in the first



hole, the pencil point in one of the others and swinging the rule, a circle may be drawn.

Contributed by

HAMILTON A. HOOPER.

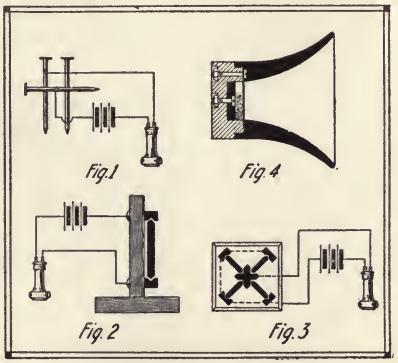


SOME SIMPLE MICROPHONES

By Kenneth Kirkwood

Microphones play a most important part in modern telephony, and for this reason the amateur should know something about them.

Probably the simplest form of microphone consists of two bright wire nails across which a fine wire or another nail is laid. The next simplest type is one which is known as the Hughes microphone. It makes use of a slender carbon rod fitted loosely between two carbon sockets on a suitable stand, as is shown in Fig. 2. The carbon rod should have pointed ends which fit into small holes drilled into each of the supports. The wires should be connected to the two end carbons. This is a more sensitive instrument than the first



Following these types, which were developed early in the career of telephony, came a number of improvements which embodied the same general principle but greatly increased the efficiency. The Crossley is one of a group of microphones which utilize carbon rods, as in the Hughes, but employ a number of rods and sockets in each instrument. This is illustrated in Fig. 3. The Crossley microphone can be made extremely sensitive. On account of the flat surface, this instrument can be placed on the under side of a table in any desired position. The series of rods may be mounted on the back of a picture hanging on the wall, and used as a dictograph for secretly listening to conversations. A thin box—a cigar box, for example—may be fitted with this microphone by placing the carbons on the back of a large, thin diaphragm which serves as the lid of the box. The diaphragm should be made of some light insulating material, such as wood veneer or hard rubber sheet. The box may be hung up over the desk or work table of the experimenter, who can thus talk directly toward the wall in front of him in order to telephone.

Following the Crossley type of microphone came the Hunnings, the first of the modern forms of telephone transmitters. In this instrument, the words are spoken into a funnel-shaped mouthpiece leading to a thin metal diaphragm which imparts the sound vibrations to a collection of carbon balls, granules or powder. A transmitter of this type is shown in Fig. 4. A number of improvements have been added to this type of microphone from time to time, but the general construction remains the same. This is the type most commonly used at the present time.

A very sensitive type of microphone is described in the February, 1915, issue of this magazine.

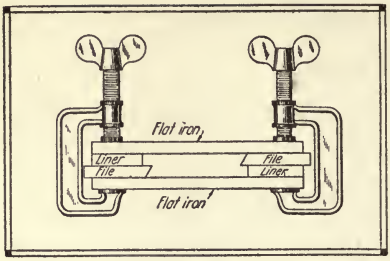
To Hold Long Board in Vise

A long board may be held securely in a vise if a hole is bored some distance away in the side of the bench and a wooden peg, or pin, inserted in it. One end of the board should be clamped in the vise and the other end allowed to rest on the peg.

Contributed by

DONALD OLSON, JR.

Have you any original ideas for this department? Why not send them in and be paid at space rates?



Shoulder Cutter for Wires or Rods

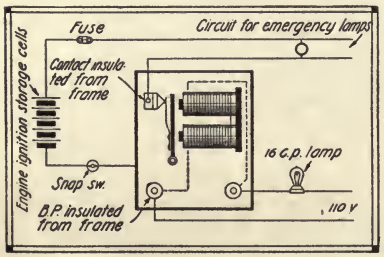
It is sometimes necessary to cut a shoulder on a rod or a length of wire. A simple tool for performing this operation rapidly can be made by grinding cutting edges on the ends of two pieces of a flat file and lining them up between strips of flat iron. They should be wedged tightly, as shown. It is obvious that the cutters are readily adjustable for large or small shoulders. The rod may be held in a chuck and should be pointed before feeding into the cutter. If the rod cannot be held rigidly, a block of steel with a V cut into its end, fastened to one of the liners, will simplify the work.

Contributed by

WM. HALK.

Battery Emergency Lamps Controlled Automatically

In small power plants the possibility of accidents to the generating machinery is always present. To forestall the confusion occasioned by the darkness which results, an automatically controlled battery lighting system should be provided.



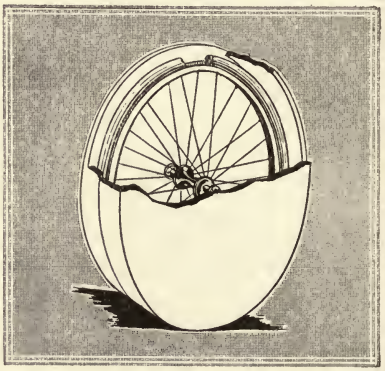
An ingenious arrangement for accomplishing this is illustrated in the drawing. Two giant magnets are fastened to a base and energized by current from the power house generator flowing through a 16 c.p. lamp. When the flow of current stops for any reason the armature is released, making contact immediately with a metal pillar directly behind it. The armature and pillar complete the battery circuit, and the emergency lamps are instantly lighted.

Contributed by

DAVID SCHELL.

A "Wrestling Cheese"

An amusing experiment can be performed with a large and thick disc



shaped like an ordinary cheese and colored—to carry out the illusion—to resemble one. If the instructions which follow are observed carefully the "wrestling cheese" which results will prove to be a veritable miracle of strength. Spectators can be invited to roll the cheese over upon its face, and a strong man can push with all his might, but the cheese will persistently remain on edge.

The outer casing of the "wrestling cheese" should be constructed of two hollow cups, 30 in. in diameter, which screw together. In the center should be placed two metal "horses," one on each side, which support an ordinary 24-in. bicycle rim with a hub and ball bearings. Into the space usually occupied by the

tire a solid lead pipe should be wound and turned so that the wheel runs true. The wheel is made to run at a high speed by bringing the surface of a fibre pulley attached to an electric motor in contact with the lead pipe. This should be done with the top of the "cheese" removed and the wheel in an upright position. The tops should be replaced and the cheese wheeled out onto the stage. The fun follows when persons called from the audience attempt to turn the cheese face down.

The action of the wrestling cheese is, of course, gyroscopic. The wheel will revolve for more than thirty minutes if the bearings have previously been well oiled.

Contributed by

JAMES MCINTYRE.

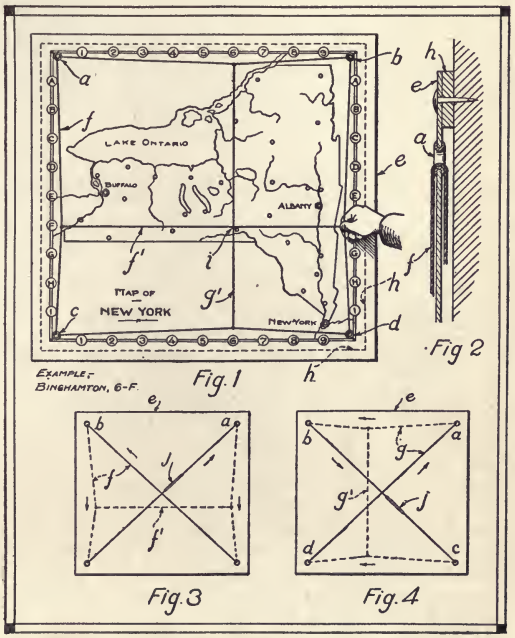
A SIMPLE FINDER FOR MAPS

By R. N. Van Buskirk

Most commercial maps have their top and bottom borders divided into several parts, the divisions having consecutive numbers and the side borders being likewise divided but having consecutive letters by means of which desired locations are found. But the trouble with these maps is that three hands are required, two for the border indices and another to hold at the intersection of the imaginary lines while the exact location of the city, street, building or company is being found.

With the attachments shown in Fig. 1 only one hand is necessary to locate a desired spot, and, furthermore, one is not required to continue to hold a finger on the map to keep the place while talking or making notes.

If the map is printed on paper it should be pasted on a fairly heavy bristol board, *e*, and the metal eyelets, *a*, *b*, *c* and *d* placed near the corners, as shown. Silk-woven fish-line should be attached to the line *f*, as shown in Fig. 3, using a strong rubber band, *j*, to keep it taut, and to this the horizontal finder line, *f'*, should be attached by knotting it securely to *f*; the line, *g*, and vertical finder line, *g'* are similar, but threaded through the eyelets differently. While the two lines, *f* and *g*, pass through the same eyelets, the action of each is independent of the other. Figs.



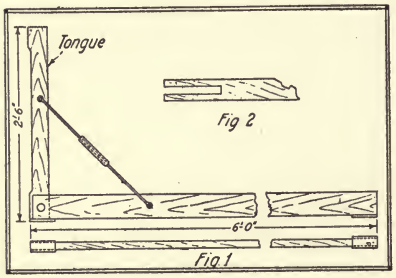
3 and 4 represent the back of the map, and the two views are presented merely for the purpose of showing clearly just how each line runs. The wood strips, *h*, should be either glued or tacked to the bristol board before attaching to the wall, and need be only of sufficient thickness to permit the lines to pass freely on the back.

With this arrangement both right and left-hand lines will travel up and down in a uniform parallel movement; the top and bottom lines will also both travel horizontally together. One hand may be used by grasping either top or bottom line at any point and shifting the line until the vertical finder line is at the figure desired; then, by grasping either the right or left-hand line and placing the other finder line at the proper letter, the desired location can be quickly found at, or near, the intersection, *i*.

Square for Fitting Doors

A square for fitting heavy doors can be made as follows:

A six-foot length of soft wood, 1⅛" x 3¾", should be sawed with a slot in one end 7/16" wide and 3" long, to receive the tongue. This is shown in Fig. 2. On the edge of each end, which will form the back of the square, a 4" length of wood, ⅜" x 1½", should be nailed and allowed to project 3/16" over each side of the body. When the square is placed on the door these strips touch the edge of the door and hold the square in place.



The tongue of the square should be 2 ft. 6" in length of 7/16" x 3" material, cut out along the top edge for clearance over any uneven portion of the head jamb. The tongue should be hinged into the slot cut in the body of the square with a 3/16" x 1⅛" stove bolt, the nut of which is set in flush with the surface of the wood. A small adjusting rod should be made 12" in length from old motorcycle spokes. The turnbuckle can be made from small lengths of tubing.

This tongue is large enough for squaring doors from 2 ft. 6" to 3 ft. 2" wide. A shorter tongue can be used with the same square for smaller doors.

Contributed by

BERT FISH.

A Use for Empty Fuses

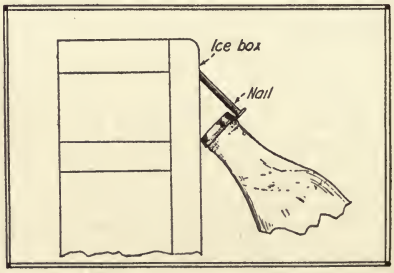
Burned-out cartridge fuses can be used for carrying small taps, drills, punches, screwdriver bits, etc. The cap should be removed from one end and the asbestos filing taken out.

Contributed by

J. SPRINGER.

Nail Removes Bottle Caps

The cap of a bottle can be removed by the head of a nail which is driven into the wall at an angle of about 45°.



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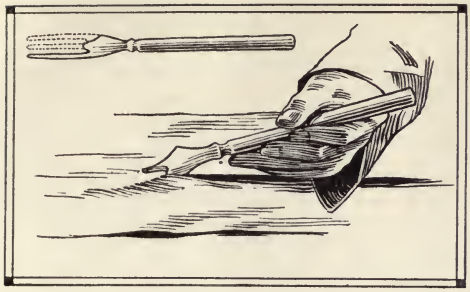
E. J. LONGLEY.



Cloth Cutter Made from Fork

A cloth or paper cutter can be made from a fork if the tines are hammered flat, two of them cut off and the edge of the remaining one sharpened.

Contributed by

F. MAURER.

To Keep Fire in Range Over Night

Fires have an unpleasant habit of going out very easily in extreme cold weather. Many northern people burn a cheap grade of soft coal and allow the kitchen fire to go out at night. This, of course, necessitates rekindling the next morning.

A very good plan is to "bank" the fire, which is accomplished in the following manner: Shake out the ashes well, and let the fire burn down to a hot bed of coals spread evenly over the grate. Put in fresh coal until the fire-box is almost full. The drafts should be opened until the bottom layer of the fresh coal has become ignited, after which the fire should be smothered with a thick layer of ashes so that they cover every portion of the fresh coal. The draft openings and the pipe damper should then be closed.

If the draft is properly checked, there will be enough ignited coke in the stove next morning for preparing breakfast.

Some difficulty will be experienced in damping the draft sufficiently to prevent the coal from burning if the stove is an old one. In this case, one of the rear lids should be removed and the cold air allowed to rush in at this point instead of through the fire-box. After a few trials, the proper adjustment of the draft can be found.

When the fire is started in the morning the grate should be shaken thoroughly to allow the dead ashes to sift through. The fire will at once begin to burn brightly and more fuel can then be added when found necessary.

Contributed by

FRANK L. WHITAKER.

An Ingenious Tray for Leftovers

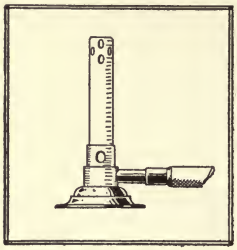
Instead of scattering small bolts, wood screws, rivets and similar articles about the top of the work bench or putting them in cans or boxes, piece by piece, a tray with a hole cut at one corner can be used, and it will be found to be a great time saver. When the tray is full, its contents can be poured into a can or box.

Contributed by

JOHN HOECK.

To Increase the Efficiency of a Bunsen Burner

The efficiency of a bunsen burner can be doubled if the air vent is closed and eight or ten small holes are drilled at the top. When this is done the burner acts as a blow torch and its usefulness for soldering is greatly increased, as it may be tilted at any angle.



Contributed by

F. B. FALKNOR.

To Protect Floor Under Baseboards

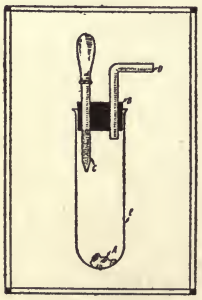
A strip of cardboard placed directly under a baseboard will adequately protect the floor while painting, staining, etc., is being done. The cardboard will absorb all stray drops of paint or stain.

Contributed by

VICTOR C. CASPER.

A Portable Oxygen Generator

For generating small amounts of oxygen for use in experiments in chemistry the apparatus shown in one of the illustrations on this page will be found very useful. A fragment of sodium peroxide should be dropped into a small test tube, and a two-holed rubber cork plugged tightly into the mouth of the tube. A pipette, *C*, containing water, should be forced into one of the holes and an L-shaped glass tube inserted into the other. When the pipette bulb is squeezed water drops upon the sodium peroxide and oxygen is instantly liberated.

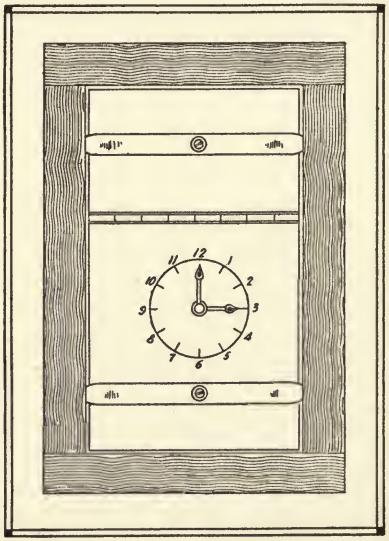


Contributed by

FRANCIS PALMER.

A Counter for Photographic Prints

When several prints are to be made from one negative the photographer very often misses count; he finds it difficult to remember just how many prints he has made and how many are yet unfinished. A print counter, or recorder, of some sort will save him time and money—in the form of wasted paper. Probably the simplest arrangement by means of which this waste can be done away with is a counter of some sort fastened on the back of the printing frame. A good plan is to mount the face and hands of an old watch on the wooden back. The minute hand may be used to keep track of the single prints made, and the hour hand will denote the dozens.



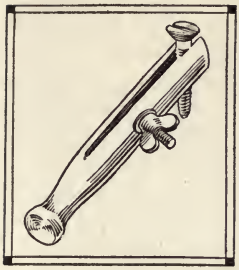
Contributed by

KARL WEGNER.

If you enjoy THE WORLD'S ADVANCE, please tell others; if not, tell us.

Hand Vise from Clothespin

A small jeweler's hand vise can be made from a clothespin by cutting off one-half inch from the ends, boring a hole at right angles to the slot and fitting it with a small clamp screw provided with a winged nut.



Contributed by

JOHN SCHMELZEIS.

Casting Small Metal Parts

Occasionally it is desired to reproduce quickly some small metal object such as a medallion or scarfpin. The method described here for this purpose involves very little labor and produces exceedingly sharp castings.

A piece of cuttlebone of the quality known as No. 1 should be obtained at a drug store. It should be divided with a sharp knife into two or more pieces according to the size of the object to be cast. Both surfaces should be filed flat and rubbed together to insure perfect adaption. The model should be placed on one section of the bone well towards the end and pressed firmly with a small stick. The model should then be tapped gently and tipped out of the impression. A V-shaped groove should be carved in the bone for a pouring gate and the second half of the mold placed in position. The molds should be bound tightly together and the casting metal poured into the gate until the mold is full. Gold and silver can be used successfully in molds of this type, but a blowpipe and bellows, together with a considerable knowledge of the properties of these metals, are necessary.

Contributed by

AUGUSTUS SAULTIS.

Ideas published in this department are paid for at space rates.

Hints to the Painter

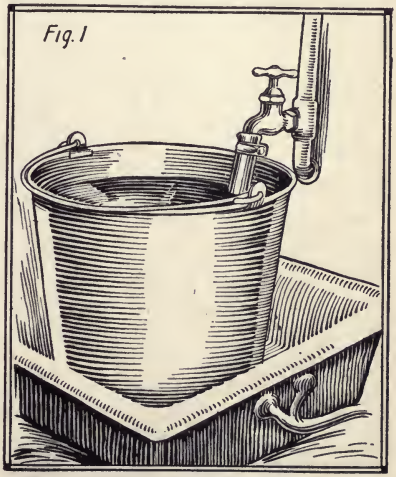
White lead naturally commences to dry as soon as the pail is opened. A coating or skin on the surface forms rapidly. This action can be prevented by covering the white lead with water. Water does not injure white lead, and it can be poured off easily when there is painting to be done. Putty kept in a tin can be protected in the same way. Paint brushes may be kept fresh in a mixture of linseed oil and turpentine. Paint brushes can be cleaned by rinsing in kerosene, after which they should be thoroughly worked out on old rags or paper. Turpentine will clean a varnish brush.

Contributed by

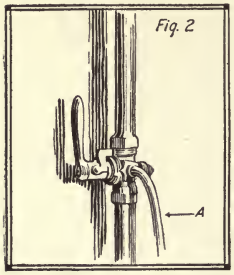
PETER SWAN.

Syphon Provides Running Water in Basement

A syphon consisting of a pail of water and a makeshift pipe line will provide running water for the photographic dark room in the basement. A small rubber hose is attached to the drain outlet indicated by *A* in the accompanying illustration. A large hose attached to the faucet on the floor above extends to within one inch of the bottom of a pail. To start the flow of water, the faucet is



opened, and when the pail is filled, the water in the basement is turned off, and, due to syphon action, water may be drawn from the pail above to the developing trays. When the pail is empty, the cut-off in the basement is opened until the pail is refilled. When the cut-off is closed the flow continues as before. If the cut-off is turned to a position half way between "on" and "off" the water will not flow in either direction, thus providing entire control from the basement.

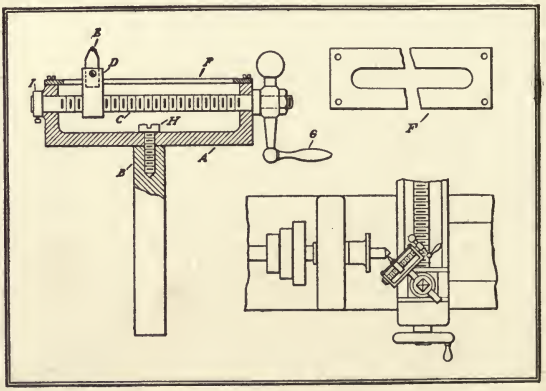


Contributed by

ANDREW G. THOME.

To True Up Lathe Centers

The majority of present-day lathes are equipped with compound rests and in such cases it is a simple matter to swing the rest to the required number of degrees to turn the centers. If the lathe has no compound rest, however, the worker must resort to one of three methods to true up the centers. One option is to use a motor tool post grinder; second, a square-nosed tool that is set at the desired angle and run up to the center by the cross feed—not a very satisfactory method, as the broad tool will usually cause chatter; and, third, to use a device similar to that shown in the accompanying illustration.



This implement really comprises a crude form of compound rest that may be made by the average workman and which may be used to turn practically any angle desired. With reference to the illustration, the framework *A* is cut from a piece of 1½-inch square steel stock and attached to the shank *B* by two heavy screws. The traveling toolholder *D* is made in the form of a long nut, having a threaded hole to engage the rod *C*, which turns in the framework and carries the toolholder throughout its length of travel. The guide plate *F* is cut from ⅛ by 1-inch bar steel and the slot should permit the toolholder to slide freely within it but without undue looseness.

The method of using the device is shown in the illustration.

Contributed by

JAS. MCINTYRE.

Cat Fishes Wire Through Ceiling

In a certain job of wiring which the writer witnessed, there was no fish wire at hand, and the electrician was puzzled with getting a wire through a 35 ft. ceiling. The question was solved finally by recruiting one of the cats in the neighborhood.

The cat was held at one opening with a twine tied to one of its legs. After a great deal of coaxing, it crawled through to the other end. Then by means of the cord, the wire was easily drawn through.

Contributed by

MAX C. VAN ANTWERP.

A Triple Mystery

by G.H.Hines

THE illusion which is described herein comprises actually three separate and distinct "tricks" which, when worked together, produce an almost inconceivable effect, although in reality they are very simple.

The effect produced is as follows: The performer first calls attention to a cabinet, about four feet long and three feet high; the cabinet being mounted on four legs which elevate it about three feet from the floor. This cabinet is placed about four feet from the back curtain.

After the performer has proved that there is no deception about the cabinet, his assistant enters and lays down on the floor of the cabinet. The curtains are drawn and at the instant the front curtain has been closed, the performer fires a pistol. When the curtains are pulled back, the assistant has disappeared.

The performer then calls attention to a small stand about a foot high and two feet in diameter, and also to a tube which is suspended about six feet above the stand. This tube is made of canvas, with a wooden hoop at the bottom; the top being cone-shaped and made of wood or some other suitable material. The tube is folded up as shown in the accompanying illustration.

Then the performer puts on a robe and mask, and places a screen behind the stand. He steps up on the stand, the tube is dropped over him, hiding him from view, and in about three or four seconds afterwards a bright light is seen to flash above the tube, which is then pulled up and discloses that the performer has vanished, his place having been taken by the assistant who had previously disappeared.

Immediately after the assistant has reappeared, a trunk that has meanwhile been suspended above the audience is let down on the stage and opened, when to the amazement of all, the performer jumps from within, thus bringing the illusion to a startling climax.

To begin the explanation, we will first look at the setting of the stage. At the back of the stage is placed the ordinary magician's back-drop, with a small opening or slit in the center. Four feet in front of this is placed the small cabinet, while in the middle of the stage is placed the small stand, with the tube suspended above it. At the side of the stage, just even with the wings, is placed the screen, and over the audience is suspended the trunk.

When the assistant enters the cabinet the back and side curtains are first drawn, and then the front. While drawing the front curtain the performer

spends a few seconds arranging the positions of the curtains. Meanwhile the plank has been pushed out from the back curtain to the floor of the stand, thus enabling the assistant to escape unobserved through the back of the cabinet. After she has safely accomplished this, the plank is withdrawn and when the curtains are drawn back the cabinet is found empty. To prevent any possibility of the board or the assistant being seen by the audience, about four or six inches of fringed material should be tacked around the bottom of the cabinet.

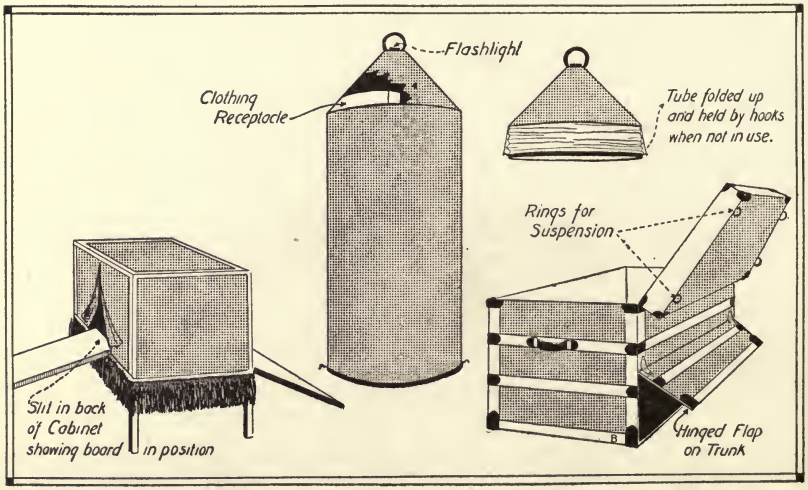
We will now go to the second part. When the performer has donned the mask and robe, he steps behind the screen as if to pick it up, but instead he changes places with his assistant who, after having passed through the back drop, dons the same costume as the performer. Thus, the assistant picks up the screen and places it behind the stand as if to box it in. It goes without saying that the assistant must be of practically the same size as the performer.

The assistant then steps on the stand and the tube is dropped over her. She then secretes her costume in a small compartment in the top of the tube shown in the illustration, and lights a flash powder placed in the top of the tube. The tube is then drawn up and the assistant is seen to have changed places with the performer.

Attention is then directed to the trunk hanging over the audience, which is then let down and placed on the stage right in front of a trap-door in the floor. The performer, who has meanwhile placed himself immediately under the trap, can then climb up into the trunk through the hinged flap on the back of the trunk. This must be worked at a fairly good rate of speed in order to obtain the most thrilling effect.

KIOGRAPHY

One of the newest things in photography is a paper on which pictures may be printed in the sunlight and then attached to any object, such as china plates, glassware, lamp shades or in a watch-case. The special paper, known as Kiograph paper, is coated with a thin tissue which is stripped after the print has been made and developed. The tissue is then placed on any object desired and adheres firmly forever, according to the inventor.



Various Pieces of Apparatus that are Used in Producing the Triple Mystery, Showing the Construction of Each.

A CRAFTSMAN SUMMER COTTAGE

Describing a Summer Dwelling that May Be Constructed by the Average Handy Man at Low Cost.*

By Ralph F. Windoes

Instructor of Manual Training, Davenport High School, Davenport, Ia.

Illustrations from drawings made by the author

WITH the materials described in our last installment purchased, our craftsman is ready to begin his building operations.

If the point of purchase was such that delivery can be made as the work proceeds, it is much the better way; but if all materials are brought to the site at one time, storage must be provided. This might be secured by renting a nearby cottage, an empty barn, or erecting a tent—the latter method not being recommended, on account of its accessibility to thieves, unless the builders are living in the same tent. Under the protection, whatever it may be, must be kept the tools, nails and other hardware, paint, roofing, cement, windows and frames, doors and frames, screens—in fact, everything that might be harmed by exposure.

The flooring and framing lumber must be carefully piled off the ground, so that there is little danger of warping.

With the materials provided, the builder must check over his tools and see if he has the following on hand. More might be handy, but these are essential:

Spade	Hand Axe
Shovel	1-in. and ½-in. Chisels
Hoe	Screw Driver
Axe	Brace and Bits
Sledge	Tin Snips
Level	Compass Saw
Steel Square	Pinch Bar
Plumb Bob	Pipe Wrench
Chalk Line and Chalk	Mallet
8 or 10 ft. Rule	Trowel (Pointed)
Steel Tape Line, 50 ft.	Cold Chisel
Hammer	Pliers
Rip Saw	18 ft. Ladder
Cross-Cut Saw	Step Ladder
Try Square	Two Galvanized Iron Pails
Jack Plane	

Of course, there should be one hammer, one square, one rule, one rip and one cross-cut saw for each workman, as these tools are being used constantly, and a great waste of time is effected if workmen are continually borrowing.

Begin the actual construction by clearing the site of the building. Remove all trees, shrubs, etc., that are liable to in-

*This article is one of a series that will appear regularly in THE WORLD'S ADVANCE until completed. The first installment appeared in the May issue, copies of which may be obtained at 15 cents while the supply lasts.

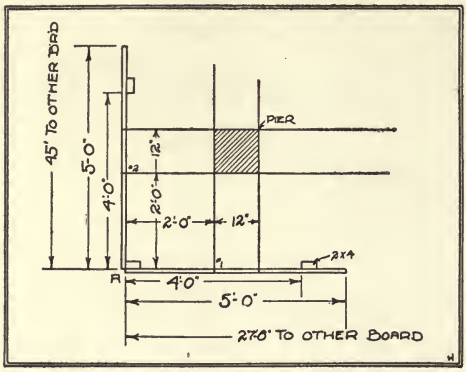


Fig. 5.—Ground Plan, Showing the Lay-out at Corners.

terfere with the building operations, and carry them to a place far enough away so that they will not be constantly interfering with the workmen.

Next, at the front left-hand corner of the plot—as you stand facing it—indicated by *A* in Figs. 5 and 6, drive a 2 by 4, pointed at one end, firmly and straight, so that about 1′ 8″ is above ground. Measure, with the steel tape line, 27′ 6″ across the front of the plot, and drive another 2 by 4 at this point, indicated by *B* in Fig. 6. The front of your finished cottage will be parallel to the tape, hence you can settle the angle at which it will face the lake, street or other objective by swinging the tape from the first stake as a center.

Now stretch a chalk line between nails driven in the two stakes, and on this line measure out from the corner 4 feet, as seen in Fig. 5. At this point drive a 2 by 4 so that the outside edge is even with this line.

Next, from corner *A*, measuring in towards the center of this same line, lay off 6 feet and mark the point. Cut a straight stick 1 inch square and 10 feet long, and with one end of this stick on the point marked, swing the other end so that it just touches the 8 foot mark on the steel tape which has been swung from *A* towards *C*, Fig. 6. This forms a right angle, and stake *C* is located, 45 feet from stake *A*. Locate stake *D* from *B* in exactly the same manner, and stretch lines around all four; then carefully drive the second and third stakes at each remaining corner.

Next, cut eight boards about five feet long and four inches wide to nail between the stakes, as seen in both Figs. 5 and 6. Starting at corner *A*, measure up 1½ feet from the ground. At this point will come the *top* edge of the boards on stake *A*. Drive one nail in each board at this point, and, placing the level on each in turn, swing the free ends up until they are level, then nail the other end. It is very essential that these boards be perfectly level, as they will locate the height of the piers, their size and their location. To locate the height of the boards on corners *B* and *C*, swing a line from corner *A* until it is exactly level, then mark

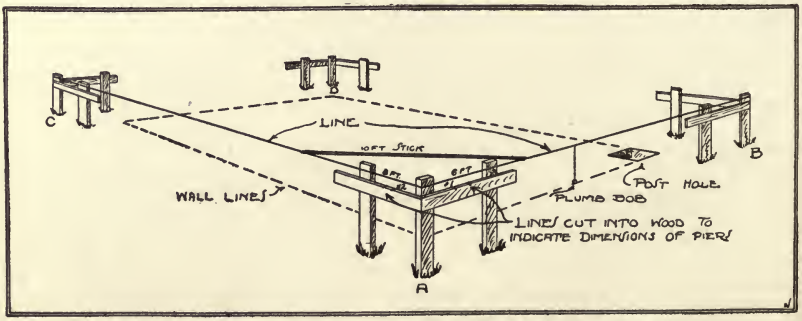
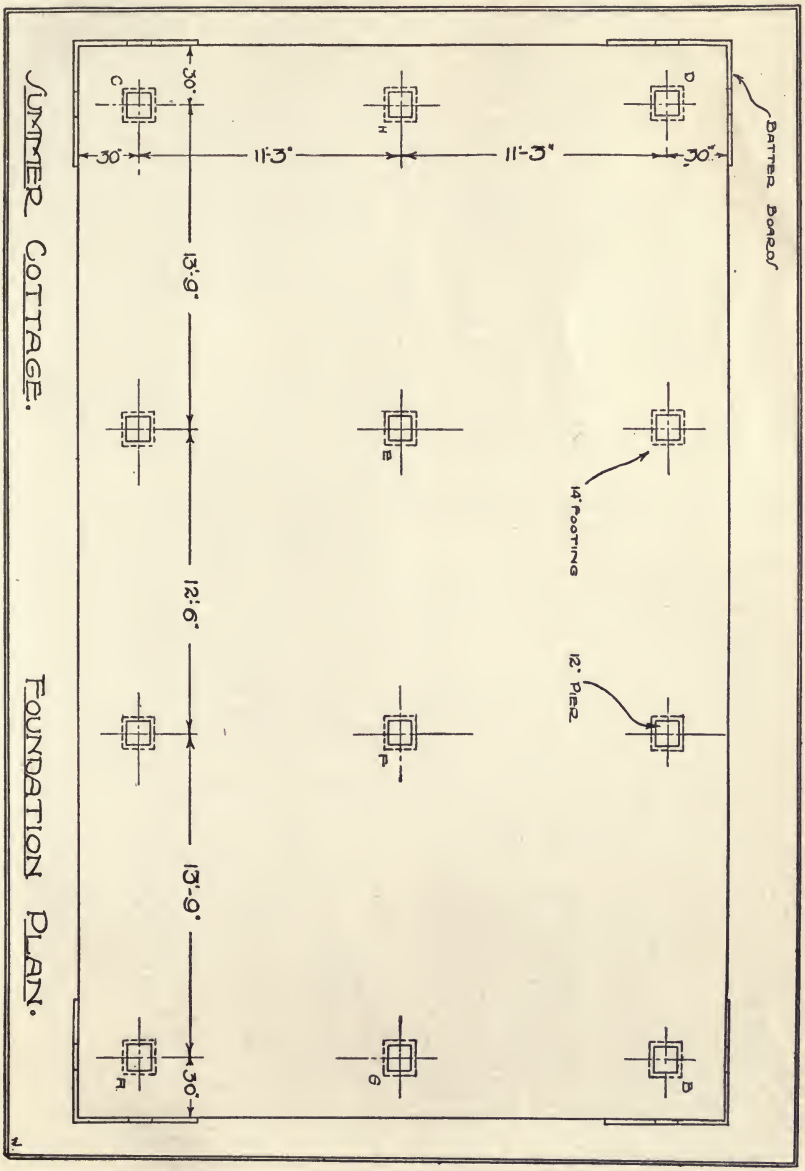


Fig. 6.—Perspective View Showing the Lay-out and Use of Batter Board.



SUMMER COTTAGE. FOUNDATION PLAN.

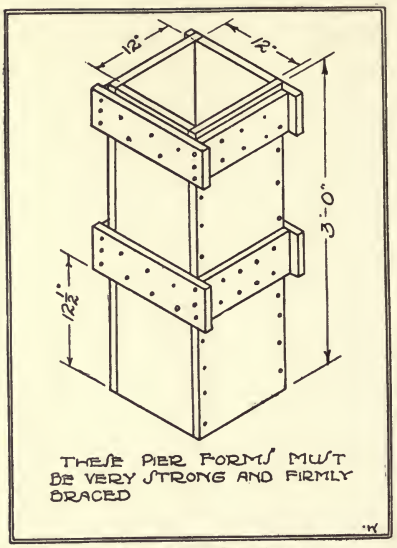


Fig. 8.—Detail of Pier Forms.

on the stakes where the line passes them. At these points fasten the remaining boards. The *D* boards will be located in the same way from stake *B*, and tested by a line from *C*.

Next, the wall lines should be located. In Fig. 5 the dimensions are given. From corner *A* measure over on the top edge of each board two feet, and make a line with a knife, or cut straight in at these points with the saw, about ⅛ inch. Measuring over from these points 12 inches, make similar cuts. These will locate the wall lines and the dimensions of the outside piers.

From line No. 1, measure across the front 23′ 6″ to locate the *outside* line at corner *B*. Then back toward *A* measure 12″ to locate the width of the right-hand wall. On the other board of corner *B* locate the cuts as was done at *A*. Similarly locate the cuts at the other corners, being careful at *C* to measure 41 feet back from No. 2 to locate the outside line cut. A careful study of Figs. 5, 6 and 7 will make this all very clear to the builder.

Now the builder is ready to dig the post holes. Through the cuts, made in the batter boards, stretch lines, and, at the intersection of these pairs of lines at the corners, dig holes exactly beneath the 12-inch squares formed. These holes will form the corners, and they should be about 15 inches square and dug to a depth that will give the builder three feet from the chalk lines. According to Fig. 7, measure down the side lines and locate the other piers of the outside walls. Dig these holes accordingly, being very sure that the work has been accurately laid out, and locate the two center piers *E* and *F* by means of lines stretched from the wall lines, and crossing at the centers of *E* and *F*. After digging holes at *E* and *F*, the builder is ready to build the forms.

Use some of the flooring for these forms, as they may be taken apart and cleaned after the piers have been cast. Fig. 8 gives a detail of the forms, and they should be very carefully made and accurate as to dimension.

Select a hard packed piece of ground upon which to mix the concrete, or, better yet, if some old boards are at hand, build up a platform about five feet wide and seven feet long. The proportions for the concrete mixture should be one part of Portland cement to five parts of unscreened gravel. Or, if you are located at a section where gravel cannot be obtained, use one part of Portland cement to two parts of sand, and four parts of crushed stone. The sand or gravel

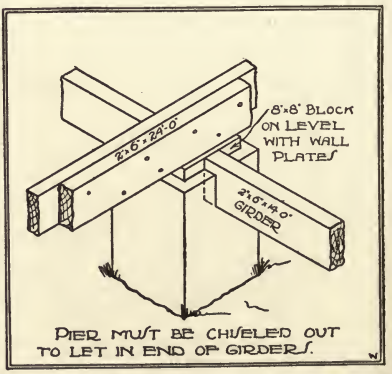


Fig. 9.—Detail of Construction at Center Piers E and F.

must be clean and free from loam. A test for loam may be made by working a quantity of damp gravel in the hands for about five minutes. If it leaves a sort of sticky clay on the hands, it contains loam and should not be used. Assuming that the builder is working near a lake, he can readily secure perfectly clean, sharp gravel without much trouble.

Empty fifteen pails of dry gravel on one end of the board or the ground space, and spread three pails of cement over them. With a workman on each side of the pile, turn all of the gravel over until it has been formed into another pile. By shoveling the sand from the bottom, the cement will roll down from the top, which assists in the mixing. The builder should make sure, if working it on the packed ground, *that he does not dig some of the dirt into the pile,* as the mixture *must be kept clean.* Turn it back again into its original position, and repeat. This means that the dry mixture is turned over three times, and, if properly done, it will have a uniform color.

Now flatten the mixture and wet it with pails of water. Turn it over the same as before, while wetting, until it becomes "mushy"; to make it more explicit, it should be of such consistency that it will *not* bear the weight of a man. Turn this wet mixture two or three times, and your green concrete is ready to pour.

Into one of the holes drop concrete to the depth of six inches, which forms the footing, and into this concrete bed one of the forms so that its top is just even with the lines. The form must also be perfectly plumb. Small pieces of wood can be placed between the sides of the hole and the form to hold it in place.

Now fill the form with the wet concrete, and tamp it down firmly with a short 2 by 4. Rough the top up somewhat, as you will later put a layer of cement upon the end in which to bed the sills, and it must have a rough surface to lay on, otherwise it will not hold.

Similarly make each pier and allow them at least 24 hours in which to set before removing the forms. If the weather is very cold or damp, give them 48 hours.

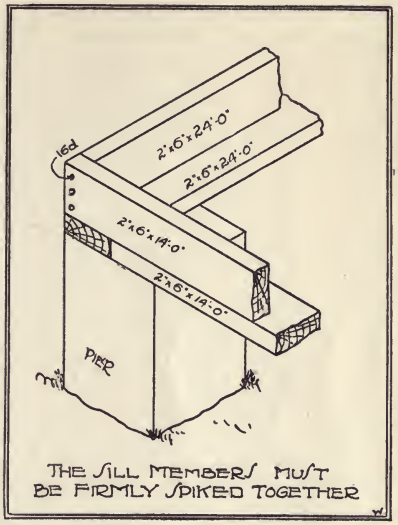


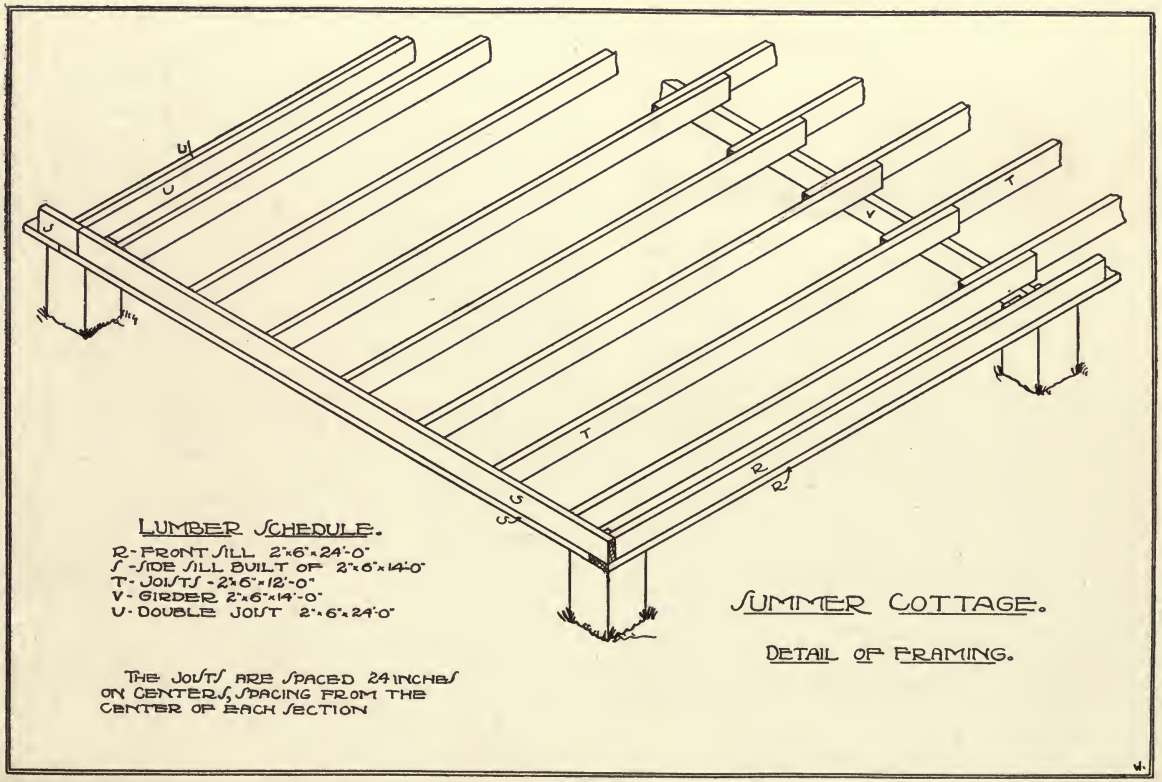
Fig. 10.—Detail of Sill Construction at Corners B and C.

It will be noticed that the girder, *V,* in Fig. 11, is set below the top of the piers, *E, F, G* and *H,* Fig. 7, which will necessitate chiseling out the concrete unless holes are made in the piers as they are cast. A simple way to cast the holes is to nail a block on the inside of the forms at the point where the girders will enter. On piers *E* and *F* there will be two holes each, while on *G* and *H* there will be but one. (See Fig. 9 for a detail of *E* and *F.*)

If the forms have been removed and cleaned up, and the batter boards taken down, the next step is to frame the floor.

A study of Figs. 10 and 11 will plainly show the construction. Notice that the 2x6's that cross from side to side *over the piers* are all one piece, while the joists between them are built up of 2 by 6 by 12's, the ends crossing on the girders *V.* The side sills are composed of lengths of 2 by 6 by 14's, the ends meeting on the piers, and the joints in both members *not* meeting at the same point.

Begin the construction by nailing up



LUMBER SCHEDULE.

R - FRONT SILL 2"x6"x24'-0"
S - SIDE SILL BUILT OF 2"x6"x14'-0"
T - JOISTS - 2"x6"x12'-0"
V - GIRDER 2"x6"x14'-0"
U - DOUBLE JOIST 2"x6"x24'-0"

THE JOISTS ARE SPACED 24 INCHES ON CENTERS, SPACING FROM THE CENTER OF EACH SECTION

SUMMER COTTAGE.

DETAIL OF FRAMING.

the end sills. For the members that lay flat, we will call them *wall plates,* select planks that are straight, and nail the upright pieces to them with the 16d nails. Notice in Fig. 10 that the uprights are set back the thickness of the side sill, and that the plates run even with the outside edges. This construction will make a more solid corner. Next, fit the side sills while the ends are in place, and firmly spike all members together. If this has been properly done, there will be an L-shaped box all around the *outside* edges of the wall.

Now mix up a rich and rather dry batch of one part cement to two parts of fine, screened sand and, lifting each corner of the sill in turn, place about ½ inch of this cement on the end of each pier. Drop the sill and proceed to the next, until they have all been bedded. Of course, if all piers have been made exactly the same height, and the same amount of rich cement has been put under each section of sill, the latter will be level, but the chances are that by sighting it the builder will find that some corner is low, or too high. Hence it will be necessary to level it up. Sighting with the eye, and placing more cement under the low parts will help a great deal, but the constructor must finally test the sill by means of a level placed on the upper edge of a *straight* piece of casing, about ten feet long. Running this diagonally on the corners will point out the low spots.

When this is as near flat as it is possible to get it, spike the two double joists that run through the center and level them up at piers *E* and *F* with blocks bedded in cement, as seen in Fig. 9. Then place the girders in the piers so that the upper edges are just even with the lower edges of the double joists, and cement in around them. Finally, nail the 12-foot joists in place, as illustrated in Fig. 11, firmly spiking them to the girders and the sill, and to each other where they cross. This completes the floor framing.

One word of caution about fitting all of this framing—*the ends of the planks must be square* as to width and thickness, especially where they fit against other pieces, as in the case of the joists.

ATMOSPHERIC ELECTRICITY AND CARRIER PIGEONS

In finding their way, birds of passage are said to be influenced by the magnetic meridian. M. A. Thauzies, a French specialist in carrier-pigeons, has recently disclosed some interesting information respecting their perception of terrestrial magnetic currents.

That the sense of direction in these birds is influenced by such currents is believed to be proven by the fact that during a day in July, 1906, and another in August, 1907, the results of numerous flights by carrier-pigeons were very unsatisfactory. Pigeon fanciers, meteorologists and astronomers who were consulted could give no explanation. A specialist in electro-magnetic research found what he believes to be a solution. He discovered the fact that on these two days an exceptional electric tension of the atmosphere manifested itself in magnetic storms. Such observations accord with the fact discovered by pigeon fanciers that, with the great increase of wireless telegraphy, much less reliance can be placed on carrier pigeons.

NEW USE FOR ALUMINUM

Recent experiments have shown that aluminum and manganese play an important part in the growth of vegetation. Professor Stoklasa, of Prague, concludes that these elements possess a special function in the process of assimilation, and his experiments have shown that it is the leaves which contain the greatest quantities of them. Gabriel Bertrand has shown that vegetable production can be increased by adding manganese to the nutrition. All vegetables that contain a certain quantity of manganese always contain aluminum.

BICYCLE SLIDING—A NEW SPORT FOR BOYS

The most up-to-date out-door sport is bicycle sliding. The bicycle sled invented by a Pennsylvania athlete makes possible

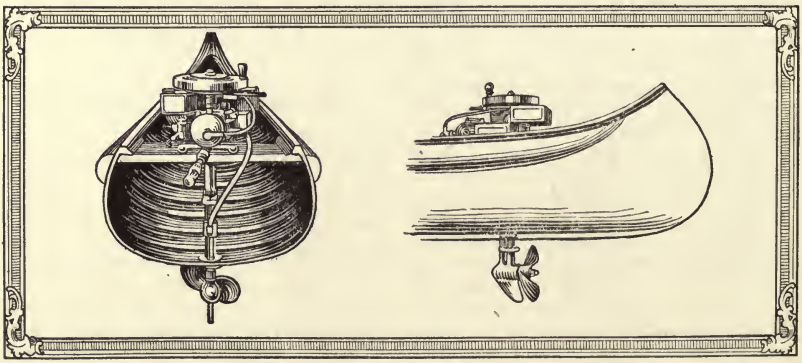
Bicycle Sliding is a New Sport that is Proving Very Popular with the Boys.

this safe and comfortable sport, which, in conjunction with the motor wheel, may yet boost the bicycle back to its former prestige. Narrow toboggan-like runners replace the wheels of the ordinary bicycle frame. A convenient foot rest is added to the frame instead of pedals, replacing the old-fashioned coasting forks. A brake shoe pivotally connected to the lower portion of the frame completes the bicycle sled. The brake shoe is normally kept in a raised position from the ground by a spring. It is fitted with a foot-braking lever extending upward from it, which, when depressed by the foot, presses the brake downward so as to engage with the ground and slacken the speed.

CONVERTING THE CANOE INTO A MOTOR BOAT

It is generally conceded by all who are familiar with water craft of all kinds that the American canoe is by far the most comfortable type of boat in which to travel. There is a smooth, gliding sensation in traveling in a canoe that cannot be approached by other types of craft.

With a view to eliminating the necessity of paddling, yet retain the advantages of the canoe, an American manufacturer has recently placed on the market a portable engine that may be installed in any canoe with practically no alterations. As may be seen in the accompanying illustrations, this portable engine is placed in the canoe and held in place by a board that also serves to



Any Canoe can be Readily Converted into a Fast Motor Boat by the Installation of a Portable Motor. As the Illustration Shows, Practically no Alterations are Necessary.

stiffen the framework of the craft. A hole is bored through the bottom of the boat to pass the propeller shaft.

A canoe fitted with the portable engine can travel at a fair rate of speed. The owner can enjoy the pleasures of canoeing without the usual fatigue incidental to paddling long distances. The engine is self-contained and operates with the minimum of noise. No rudder is necessary, the propeller being swung from one side to the other by means of a suitable handle for altering the course of the craft.

SPECTACULAR ARTIFICIAL ERUPTION OF A VOLCANO

The genius of the lighting experts of the exposition at San Francisco was responsible for a most remarkable volcanic eruption which took place on the evening of March 10th. The long-dormant Mt. Tamalpais, familiarly known as "The Silent Sentinel by the Golden Gate," belched fire and smoke from her lofty summit in a most realistic manner. Five tons of fire and smoke producing combustibles were burned in the gorgeous display, and the grand old mountain painted the sky with lurid hues in her answer to the giant searchlights on the exposition grounds. The unique spectacle was planned as a fitting celebration on the eve of the Marin County day at the Fair, and, as it had been previously announced, the entire populace of the Bay cities was watching for the unusual sight.

MOTOR TRUCK VS. HORSE

Reduced to simple terms, the comparative cost of hauling material by horse cart and by auto truck have been worked out by the engineering department of the city of St. Paul, Minn. The final figures show that for anything up to a one-half-mile haul the motor truck is more costly than the horse-drawn vehicle. Between one-half mile and one and one-half miles the cost is about the same, slightly favoring the motor truck, however; while for any haul above one and one-half miles the motor truck is decidedly the cheaper. In working out the comparative figures it was assumed that a team had an average speed of three and one-half miles per hour and could be employed at a cost of $6 per day, while a motor truck had a speed of 11 miles per hour and cost $20 per day to operate.

SOIL RADIATION AND HEALTH

It has been suggested by the distinguished British scientist, Professor John Milne, that certain experiments made by him, showing that photographic effects are produced by some form of radiation from chalk and granite in the Isle of Wight and Cornwall—radiation which he thinks is probably of an electrical nature—may possibly throw light upon differences of climate observed in places which are relatively near together. Further research, he thinks, may perhaps show that the well being of living things on the surface of our earth is more dependent upon its radiations than has hitherto been supposed.

The German army in its recent terrific assault upon the Allied line in Flanders employed a deadly gas to overcome its enemies. According to good authority, it is gathered that the Germans employed compressed chlorine in tanks. Before an attack and when the wind blew towards the trenches of the opponents, the Teutons released the gas, which floated over the Allied lines, killing many of the soldiers. This yellowish gas is exceedingly deadly, and proves very effective in this connection because of its great weight.

How to Build and Use a Sailing Canoe

By Chas. A. Meyer

CANOEING, though a popular aquatic sport in America, is not enjoyed as extensively as it might be for the reason that many cannot afford to purchase a suitable craft. It is the purpose of this article, therefore, to explain as simply as possible how anyone, possessing sufficient mechanical skill to manipulate a hammer and saw, can construct, at but a slight expense, a serviceable canoe.

The pleasure of canoeing is greatly increased by the addition of a sailing-rig. It is generally supposed that a canoe is a very dangerous craft, liable to capsize at the slightest provocation. But this is not the case. When properly handled, a canoe is a reliable and safe craft, even when equipped with a sail.

Construction of the Canoe

It is advisable when building a canvas-covered canoe to first construct it upon a temporary base, *A*, Fig. 1, which is removed later. Select for this purpose a board 14 feet long, 1 inch thick and of any convenient width.

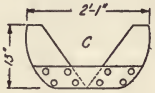
The stem and stern pieces, *B*, Figs. 1, 3 and 4, are made of any variety of tough wood which is capable of being bent to the required shape. Green elm, ordinarily obtainable at a carriage maker's shop, is admirably adapted to this purpose. Two pieces are needed, each measuring 33 x 1½ x 1 inches. The wood may be rendered pliable by soaking it in boiling water.

A number of molds are required to give form to the frame while the ribs are being put in place. These auxiliary parts are built up of pieces of wood 1 inch thick, as illustrated at *C*, Fig. 2.

The gunwales, *D*, Figs. 1 and 4, comprise two pieces of straight-grained wood, preferably ash, 15 feet long, 1 inch wide and 1 inch thick. They should be lightly nailed to the molds. At the ends they are *beveled* to form a joint as shown in Fig. 4. Two additional strips, *E*, on each side, are temporarily put in place.

The ribs are formed of strips of elm or hickory 1½ inches wide, ⅜ inch thick, and long enough to reach from gunwale to gunwale when bent as per diagram.

Fig. 1



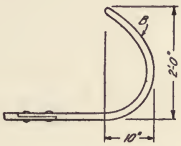
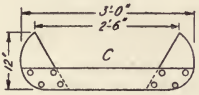


Fig. 3

Fig. 4



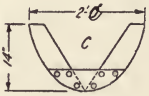


Fig. 2

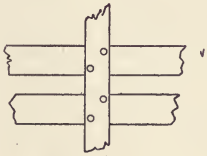


Fig. 5

Fig. 6

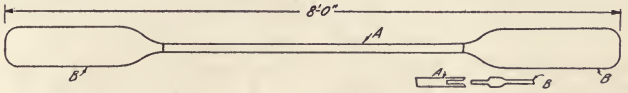


Fig. 7

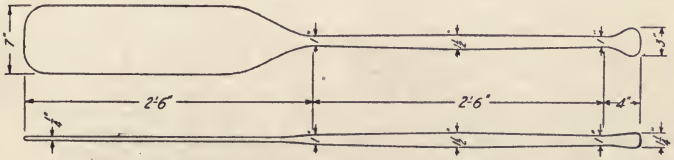


Fig. 8

The Different Parts of a Canvas Canoe, as Well as the Double and Single Paddles.

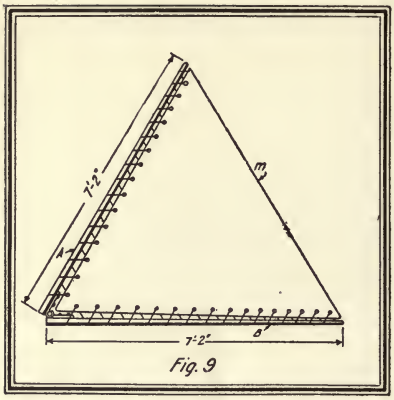


Fig. 9

Details of the Sail to be Used in Connection with the Canvas Canoe.

Soak the strips in boiling water or steam them until they can be readily bent to shape. The best method of setting the ribs is as follows: Beginning at the center of the boat, place a rib upon the upper side of the base, *A*, and secure it in place with a nail. Then, following the curve of the molds and strips *E*, bring the ends up to the gunwales, where they are fastened with brass screws. Continue in this manner, spacing the ribs one inch apart, until they are all in place.

The temporary base may now be replaced by a permanent one and the molds removed. This new base is a strip of strong, clear-grained wood measuring 2 inches wide by ⅝ inch thick. It is joined to the upper side of the ribs with brass screws and to the stem and stern pieces as shown in Figs. 3 and 5. The two upper edges are finished off with a ¼ inch bevel. Two wicker seats are placed five feet from each end of the canoe. The two end pieces, *F*, are cut from ⅜ inch thick board and are held in place by finishing nails driven through the gunwales, as depicted in Fig. 6.

Cover the frame with a heavy grade of canvas, applied to the bottom or under side. Procure a strip of material 18 feet long. Locate the center of the strip and tack it to the ribs opposite the floor-piece with copper tacks. Then, working from the center of the boat, tack the cloth to the ribs and gunwales, always keeping it taut and free from wrinkles. At each end it will be necessary to split the cloth in order to make it fit neatly. When this has been done, trim off all the surplus material.

When the operation of covering the frame has been completed, give the canvas a coat of thin glue to shrink it. Sheet glue, heated with water in a glue pot or double boiler, is best for this purpose. After the coating of glue has thoroughly dried, apply two coats of paint and stain the interior wood work with waterproof varnish. A light keel of hard wood, 1 inch wide by ½ inch thick, although not absolutely necessary, will serve to protect the bottom of the canoe when landing in shallow water.

The Paddles

There are two general types of paddles, single and double. The double paddle consists of a central pole, *A*, Fig. 7, of spruce or ash, 6½ feet long and 1¾ inches thick. The two ends are shaped as shown to receive the paddle blades. These latter, *B*, are cut from pieces of spruce 12 x 9 inches. The blades are fitted to the pole as illustrated.

By carefully studying the plan given in Fig. 8 it will be understood how to cut out a single paddle. Spruce is well suited to this purpose, since it is strong, light and easily worked.

The Sailing-Rig

For a canoe of this size, a sail of about 40 square feet is large enough. What is known as the "Lateen" rig is generally used in this type of sailing craft. The sail has the form of an equilateral triangle, 7 feet on a side. The mast also is made in the form of a triangle.

The spars for the sail are two round spruce poles, *A* and *B*, Fig. 9, 7 feet 2 inches long and 1½ inches in diameter. They are joined at one end by a hinge.

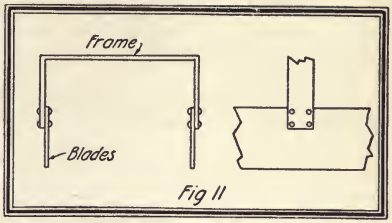
The mast consists of two spruce spars 5 feet long and 1 inch in thickness, joined at the top with screws and separated at the bottom by a strip 1 inch square. This

last named piece is made just long enough to cause the base of the mast to fit snugly in the bottom of the canoe.

The sail should be made of light weight canvas or duck. A hem is made along each edge and a length of ¼ inch rope is run through the free edge, *m*, as shown in Fig. 9. Eyelets along the other two edges provide means for lacing the sail to the spars.

Assemble the complete rig as follows: First screw the mast to the bottom of the canoe 4 feet from one end. Two wire stays, *M* and *N*, Fig. 10, fastened to the gunwales, and one bow stay, *P*, hold it rigidly in place. Attach a rope to the upper sail spar 2 feet from the hinge joint, and, after passing it through a pulley at the apex of the mast, fasten it to a cleat, *S*. This arrangement allows the sail to be raised or lowered at will. A short length of rope at *T* holds the lower spar in place, while still another piece, *U*, controls the swing of the sail.

In order to keep the canoe from "sliding"—that is, drifting sidewise before the wind—a lee board is necessary. This attachment consists of two cedar blades 4 feet x 12 inches, mounted on a frame that fits over the gunwales, as illustrated in Fig. 10. The frame is composed of two pieces of wood, 1 x 4 x 15 inches, joined at right angles to a third piece



Details of the Frame and Cedar Blades.

measuring 1 x 4 x 30 inches. (See Fig. 11.) The entering edges of the blades should be beveled to a sharp edge in order to reduce the head resistance of the water.

Handling a Sailing Canoe

A few words of advice regarding the management of a sailing canoe may be of service to the uninitiated. To begin with, it should be borne in mind that when sailing, the paddle serves as a rudder.

The sailor sits in the bottom of the canoe, more or less on the side opposite the sail, according to the strength of the wind. In a very stiff breeze, it may even prove necessary to sit on the gunwale to preserve the equilibrium of the boat.

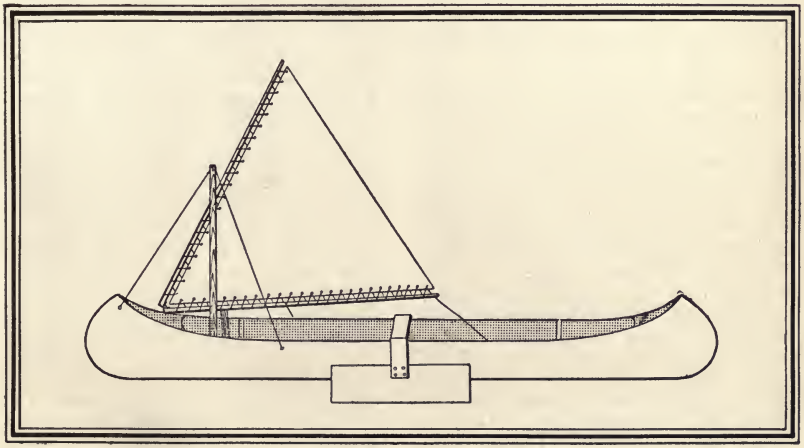


Fig. 10.—Canvas Canoe Complete, Showing Method of Attaching the Two Cedar Blades and the Sail.

As to "tacking," "going about" and other manoeuvers, a sailing canoe should be handled in the same manner as any other sail boat.

The amateur canoeist should learn to manipulate his craft in shallow water and where there is the least danger should he be in trouble. It is only after he has become competent and understands his canoe thoroughly that he should venture far away from land and in deep water on long journeys.

POWER FROM PEANUT-OIL

It seems that one of the advantages of the latest type of Diesel oil-engine lies in its ability to produce power by burning not only the cheapest grades of natural mineral oils and the by-products of coal distillation and coke plants, tar and cresote oils, but also vegetable and animal oils. Indeed, it is claimed, it can use peanut oil almost as effectively as mineral oil. The use of fat oils from vegetable sources for fuel will, it is predicted, promote industrial development in regions where the cost of coal is prohibitive—in northern Africa, for instance, and in many parts of our own country. The inventor of the engine declares that those oils make it certain that motive power can still be produced from the heat of the sun, even when all our natural stores of solid and liquid fuels are exhausted.

VENTILATORS IN THE HAY MOW

Air drainage in the hay mow is necessary. Thousands of tons of market hay are annually ruined as a result of molding, heating and firefanging caused by the storage of the feed in tight barns, where the fresh air has no chance to circulate and aid in curing the forage. This loss is easily and cheaply controlled. It is necessary to lay a system of wooden ventilators through the hay mow so that a complete circulation of air is obtained. The ventilators are about ten inches square and appear as four-sided ladders, since the sides are left partly open, so that the air current which constantly passes through the ventilator, is able to penetrate the hay.

The length of the ventilators is determined by the width of the hay mow, as the aim is to have the open ends of the drains at the opposite sides of the mow. The ventilators are spaced about fifteen feet apart and a layer of them is placed through the mow to every six feet in depth of hay. It involves a little trouble to build and arrange these air-drainage tiles in the mow, but the work pays big returns. In one hay barn where this system was employed, 1,000 tons of hay have been stored during the last four years and none of it has molded or firefanged. Previous to the use of the air drainage system fifty tons of hay were spoiled for market purposes in one season in this barn, with a resultant loss of $1,000.

MUSK IN CHEAP PERFUMES

The chief ingredient of low-priced perfumes is musk, a substance derived from various species of animals, of which the muskrat is the best known.

As an article of commerce, however, the musk supplied by civet cats is probably the most widely sought. The odor is strong and sweet, but in its strength lies the particular reason for employing it as the base of perfumes. The visitor to any zoölogical institution that possesses specimens of these cats can, if he be of an investigative turn, easily catch the musky odor from their cages.

But little musk is required to give the most lasting odor to an ounce of perfumery. The musk itself, however, is not cheap, since much time and labor must be given to the task of collecting it.

This magazine is now located in its new home, 239 Fourth avenue, New York City. Much time may be saved by addressing all communications to the new address.

Electric Lights for the Summer Cottage

WITH the publication of the details of the interesting little summer cottage in Mr. Windoes' article in the current number of this magazine, it seems likely that many readers will seriously contemplate or actually start the construction of one of the cottages in anticipation of the summer months to come. The editor of this department has studied the plans for the cottage with more than a little interest and with this examination has come the belief that herein may be found an excellent opportunity for the electrical handy man to exercise his ingenuity in the design and installation of an electric lighting equipment for the cottage.

In considering such a design the first requisites which come to mind are as follows: The equipment must be low in cost in order that the necessary expenditure may be commensurate with the cost of the cottage as well as with the usefulness of the lighting plant; it must be perfectly simple in operation in order that its use may not involve labor which would place the equipment in the category of nuisances; it must, above all, be practical in the supply of a useful volume of light and not merely a toy that looks pretty in theory but which fails dismally in its mission when the camping party is perhaps forced to remain indoors on a rainy evening and when a good, strong reading light is a blessing.

Summing up these specifications, there occurs to the thoughtful reader but one solution of the problem. The answer is found in the modern automobile lighting equipment with some modifications. Obviously, if the cost is to be within reason, the most expensive part of the entire outfit—the storage battery—should be so arranged that it may be used, not only in the lighting of the house, but for the motor car as well. It is here assumed that the builder of the cottage or else some member of his camping party owns a car of some sort; or if not a car, then a motor boat. If such is not the case, the only alternative is to add a small generator and gasoline engine to the lighting equipment, unless there should happen to be a small waterpower available near the site of the cottage. The case of the complete isolated plant, however, requires a different treatment and, while a six-volt installation is contemplated in the present article, the complete generating plant permits of the use of a higher voltage which is advantageous to a degree. Assuming, however, for the sake of coherence in this article, that the cottage owner has access to a car or boat engine and small lighting generator, we may proceed to consider how the plant may be arranged to take care of the house lighting.

The greatest advance in interior lighting equipment in recent years was made when the mazda lamp was perfected. Now, to cap the climax, we have the nitrogen-filled lamp, which is very nearly 100 per cent. greater in efficiency than the ordinary mazda, and what is of greatest moment in our own case is the fact that the nitrogen-filled lamp is now available in a 6-volt, 21-candlepower size. This lamp consumes about 13.65 watts and gives a light that, when properly

shaded, is ideally adapted to the present requirements. This, then, solves the problem for the units of greatest power that we shall require for the living room and the combined dining room and kitchen. The sleeping balconies may have a 6 c.p. mazda lamp each, above them, and the porch should also be similarly equipped.

Assuming two of the 21 c.p. lamps in both living and dining rooms and the three 6 c.p. lamps in the remaining nooks, we have a total wattage of 54.60 for the nitrogen and 18 watts for the mazda lamps, or a total of 72.60 in all. If every one of the lamps were to be turned on at one time, the current would reach rather more than 12 amperes, but in view of the fact that the various members of the party would scarcely be so distributed about the cottage that they would require all of the lamps, since such a use would involve the combined occupations of sitting on the porch, retiring, reading, cooking and eating. Therefore, we may estimate that the average peak load, so to speak, would be in the neighborhood of six amperes. For a compromise in the selection of our battery, we may say that the battery should be capable of standing a discharge of eight or ten amperes for ten hours.

An examination of the data supplied in connection with several prominent makes of lighting batteries discloses two models either of which should serve our purpose admirably. The advantage to be found in the larger battery is principally in its ability to stand up under harder usage and in the fact that the recharging need not be done so frequently. The specifications referred to are as follows:

6-Volt	60-80 Amp. Hrs.	37 Lbs.	Price $16.00
6-Volt	80-100 " "	49 " "	22.00

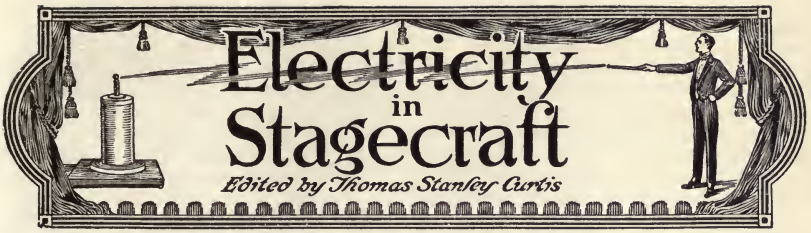
In the recharging of the battery it is intended that the case shall be placed in a carrier on the car or in the motor boat in order that the charging may be done while the engine is running, and without necessitating a special run of some ten hours solely for the purpose of charging the battery. If the battery is placed in the car each day, or perhaps every other day, sufficient charging will be done to keep it in good shape during the ordinary course of running about.

The selection of the lighting fixtures should properly rest with the individual. The use of lamps equipped with one of the miniature bases is strongly recommended, first, because such bases are now standard in automobile lighting equipment, and, secondly, because these lamps are much cheaper than the low-voltage lamp fitted with a standard Edison base. The lamps may be fitted either with the candelabra Edison base or the Ediswan type. The latter has advantages in point of positive connection and easy removal.

The sockets, switches and wiring may be of the standard or the miniature character. Adapters are provided whereby the candelabra size of base will be fitted to a standard socket which offers the advantages of cheap and readily obtainable shades and other accessories. However, if the scheme of everything in miniature is to be carried out—and for the sake of appearances this is recommended—the small fittings may readily be obtained, even to tiny push switches for the wall and dome lights for the ceiling. Space will not permit of the illustration of these many interesting little fixtures but the reader has only to send for the catalogue of any prominent electrical supply house for the fullest information and prices.

The wiring of the cottage is an important consideration for the voltage is so low that the distribution must be correct in order that all lamps may burn at full candle power. This article may therefore be considered as an introduction to the subject and for those who contemplate an installation it is suggested that they secure an abundance of catalogues and become familiar with the names and uses of the various fixtures which will be referred to in the next article. The complete wiring diagram for the house will be worked out in the July issue of THE WORLD'S ADVANCE.

If you enjoy THE WORLD'S ADVANCE, tell others; if not, tell us. Have you any suggestions to make? If so, send them in.



The Electrical Entertainer's Program*

THE selection and preparation of the experiments to be used in his program must needs rest with the entertainer himself. The work must show the individuality of the entertainer, since he is to perform the experiments and is responsible for their reception by the audience. The hints offered in this article should, therefore, be considered in the light of suggestions only, and the most the writer can hope is that they will start the entertainer on the right track. Constant experiment day after day will serve to bring out the wonderful possibilities in the apparatus, and as the worker proceeds he should make note of the effects produced and strive in future attempts to make the manner of presentation more striking and interesting. The one big thing to be borne in mind, as outlined in the last article, is that the experiments must hold the interest of the audience without the necessity of discourse or explanation. In the first place, the high frequency discharge produces a deafening noise which in itself renders speech inaudible while the coil is in operation, and, secondly, the audience as a rule does not care what the entertainer has to say and it must be shown. Simplicity should be the keynote throughout, for the average theatre audience may be treated as a more or less unruly crowd of children who want solely to be amused and entertained. With these facts in mind, the entertainer may plan his program. The number of experiments is seemingly limitless when one starts to operate the apparatus, and as the time allotted the average feature act in vaudeville is from twenty to thirty minutes, it is obvious that only the pick of the lot should be chosen. Some may be selected for their beauty, but the majority should be picked with a view to their sensational qualities.

Probably the most effective opening number is produced by the high frequency transformer in operation at full power with a dark stage. The streamers of fire leap out for several feet in all directions from the ball atop the transformer. The discharge makes a tremendous crackling and crashing noise which impresses the audience through its weirdness even before the curtain rises. As the curtain ascends, the center of the stage appears to be filled with a twisting, darting mass of slender, purplish fingers of fire which snap at the entertainer as he enters through the center door and walks down stage or toward the footlights. The current may at this time be shut off and the lights turned on full for the opening remarks which were discussed in the preceding article.

After the short preliminary address the performer may briefly explain to the audience how modern science enables man to make electricity his servant, and a servant whose services are to be respected but not feared. For instance, he can say that if he were to place his hands across the terminals of the low frequency transformer (pointing out the instrument, but not explaining its prin-

*This article is one of a series that has appeared in past issues of *Modern Mechanics* and THE WORLD'S ADVANCE since September, 1914. Previous installments have covered the construction of the apparatus referred to in this article. The demand for the back numbers has been so great that several issues are now out of print and can no longer be supplied. The author has in preparation, however, a very complete book dealing with this subject in a thorough manner and interested readers may obtain information relative to the work through our Book Department.

ciples) he would receive a shock that would positively be fatal, since its voltage is in excess of that used in the electric chair. He may then go on to say that through a simple process of conversion which changes the nature of the current but which does not in any way materially reduce its strength, and which, indeed, serves to increase its voltage to near or quite the million mark, he is enabled to apply that erstwhile destructive force to the good of mankind, curing diseases, relieving pain and in countless other ways fulfilling the claim that electricity is man's greatest servant when intelligently handled. The performer may then show how the tremendous current can be taken through the body without danger, even though its voltage is hundreds of times that used for purposes of electrocution. A metal rod is grasped in the hands, and while standing on an insulated stool the performer approaches the ball discharger of the transformer with the lights out and the coil in operation. As the rod nears the ball a beautiful halo or luminous vapor gathers at the point and increases in intensity as the distance is shortened. Finally, when the rod is within four or five feet of the ball, an enormous sheet of purplish-white flame crashes across the intervening space and into the rod held in the hands. The spark leaps into the air and breaks as the heat causes it to rise, and the moment the discharge is broken another flame takes its place. If the distance is shortened to within six inches or a foot of the ball, a piece of stick or bit of paper held in the spark will be ignited immediately.

The performer may then withdraw and have the current turned off for a few words of explanation. The next experiment may be made to show that the current is actually going into the body of the entertainer. To this end, he approaches the ball with his rod held in one hand and in the other he grasps an electrode to which is connected a wire leading to one terminal of an incandescent lamp. The other terminal of the lamp is attached to a second electrode which is held by the assistant. When the current is turned on the spark leaps to the rod as before and the lamp is lighted to full incandescence or even burned out by the current passing between the bodies of the performer and his assistant standing nearby.

WHY ALCOHOLISM MAY PRODUCE FATNESS.

It is noticeable that those addicted to the use of alcoholic beverages often reveal a tendency to corpulence which is proportionate to their use of the drug. This is sometimes taken as an indication of health and is often pointed out by the defenders of the drink habit as being sufficient proof of the harmlessness of the use of such stimulants. This fatness, however, is not a sign of health. It is not even an indication that alcohol is harmless. It is merely the result of the complete oxidization of the substance of alcohol by the human body. In other words, the fact that the absorption of a protoplasmic poison is complete rather than partial. The body will oxidize a two ounce quantity of alcohol in twenty-four hours, and will do it so completely that no trace of alcohol can be found in any excretory substance.

This simply means that the unnatural heat produced in the body by the presence of the stimulant answers, for the time being at least, for what would otherwist be produced by the expenditure of fats and carbohydrates. These latter are the fuel stored up by the body and normally burned up in the production of necessary bodily heat. When alcohol is consumed it furnishes heat—though not a natural heat—and this expenditure is avoided. The fat is therefore stored up in the body unused, and corpulence is the necessary result.

This, of course, is not a normal condition nor a proper process. It becomes more unnatural with increasing use of alcohol.

Practical Electro Therapy

Edited by Thomas Stanley Curtis

High Frequency Apparatus*

DISREGARDING for the moment the effects of the various frequencies upon the body, we may turn our attention to the broad classifications given by the manufacturers of apparatus to the currents produced. The classes are in the main but three: the Tesla or high potential current, the D'Arsonval or medium potential current, and the Thermo, or as it is sometimes called, the Thermo-Faradic current which is of comparatively low voltage as high frequency currents go. In order that the respective uses of the three currents may be the more fully understood, it is proposed to treat them under their proper headings.

THE HIGH POTENTIAL OR TESLA CURRENT.

This current is that taken from the terminal of the post which tops the high frequency apparatus and it is generally applied through a vacuum electrode of glass which is held in an insulated handle of suitable form. The application is quite without pain, and, in fact, without much of any sensation other than gentle warmth, unless the electrode is lifted from the skin in which case the resultant spark is rather painful. Therefore, one of the first points for the operator to impress upon his mind is the fact that the electrode should never be applied or taken away from the patient without the operator placing his own hand upon the glass to divert the current from the patient. The entire success of the electro-therapeutic treatment may be said to rest in the practitioner first of all inspiring confidence in his patient.

The most pronounced physiological effect of the high voltage current is shown in the increase of blood supply to the part under treatment. This results in an improvement in the local nutrition. Other characteristic effects are an increase of heat locally without a rise in the body temperature, a marked increase in excretion and secretion, and a general effect which may be either sedative or stimulating accordingly as the current is higher or lower in frequency.

In at least one particular can the vacuum tube application be said to be the direct opposite to the low voltage or D'Arsonval treatment. The effect of the vacuum tube treatment is to increase the arterial tension when the tube is passed up and down the spine, while the auto-condensation treatment with the D'Arsonval current is exceedingly efficacious in reducing the blood pressure. The pertinent fact here is to note that in cases of arteriosclerosis, the application of the vacuum tube to the spine should never be made. However, where the blood pressure is found to be normal, this treatment is of great advantage in producing a general tonic effect upon the system, particularly if a moderately low frequency is used.

In cases of alopecia and other diseases of the scalp and skin the vacuum tube treatment has been found invaluable. The treatment has received a large amount of publicity under the misnomer of "The Violet Ray," and so far has this misleading advertising been carried that the treatment has frequently been condemned as quack. The violet ray part of the proposition is simply a fascinating and perhaps mysterious-sounding trade

*This article is the fourth of a series on high frequency apparatus. The first article appeared in the March issue of *Modern Mechanics*.

name which was undoubtedly coined as a result of the appearance of the vacuum tube when the current is passing. The interior is filled with a purplish blue light which has lead to the deception which, while it makes no claims definitely, leaves the uninitiated under the impression that the treatment is in some way associated with the famous ultra-violet ray of Finsen. The fact of the matter is that even though there were an appreciable amount of ultra-violet light generated within the tube (as is probably the case), the glass walls are practically opaque to the ray and its passage to the patient would be stopped. However, beyond the mere fact that this slight deception has lowered the dignity of the treatment and has made it a name almost as common as that of a patent medicine, the incident need not concern us. The merit of the high frequency current properly applied is now definitely established beyond question, and the physician who first learns its powers and then uses it honestly is sure to derive everlasting satisfaction from the treatment.

The treatment has met with the most encouraging success in the stimulation of the growth of hair on heads not hopelessly bald, and the experience of a number of prominent workers goes to show that even gray hair may be restored to its original color through a perfectly natural process. While success has not come in every case, still the results are so encouraging that the writer believes he is justified in stating that this treatment offers a distinct opportunity to the scalp specialist who is willing to apply himself with the same diligence that he would bestow upon some unfamiliar but promising drug. The effects of the treatment are cumulative, and in stubborn cases patience is necessary, for while the first few treatments do not perhaps have the desired effect, the cumulative characteristics come out after persistent administrations.

For the application of the high voltage current vacuum electrodes are made in almost every conceivable form. The scalp is treated with a sort of rake or comb electrode; the cavities are approached with forms expressly made for the purpose, and for general bodily application a variety of surface electrodes may be obtained.

(*To be continued in the July number.*)

MARINE SURVEY DISCLOSES MENACES TO NAVIGATION

In that portion of southeastern Alaska forming the well-known inside passage followed by steamers, in a distance of 42 miles of ship channel, there has recently been discovered by Field Agent J. A. Daniels of the United States Coast and Geodetic Survey 21 pinnacle rocks hitherto unknown to navigation. One of these rocks, described as a submerged Washington monument, is 600 feet high and rises to within 17 feet of the surface. All of the rocks are located in water of from 20 to 100 fathoms deep.

When the original soundings were made it is probable that if the lead struck any one of the pinnacles it slipped off into deep water, thus failing to reveal the danger which of course could not therefore be charted. In locating these rocks a wire drag about a mile long, supported by cables to surface buoys and towed by small boats, was used. When the old survey was made the wire drag was not in use, and before this last survey four pinnacle rocks were discovered in this 42-mile stretch by ships being wrecked on them. They are named for the ships that were lost—the Idaho, Ohio, Potter and California rocks, respectively. The area covered by the wire drag was 60 square miles and it cost $675 to discover each rock. The Department of Commerce states that the cost of the wreck of the *State of California* was 31 lives and $300,000, so that this wreck alone would pay for the location of 400 pinnacle rocks, or would run a wire drag party for twenty field seasons of three months each.

If Congress will appropriate the necessary funds the work will be continued with vigor, so that mariners would feel safe in sailing those uncertain waters. Hundreds of miles are yet to be surveyed.

Electricity in Horticulture
Edited by Thomas Stanley Curtis

Plant Culture by High Frequency Current*

Part IV. Construction of the High Frequency Coil

IN previous articles the reader has been told of the construction of the transformer which steps the commercial lighting current up to a potential of several thousand volts, the condenser which stores up this high voltage, and the spark gap or discharger across which leaps the stored-up current in the condenser. The discharge of the condenser across the gap sets up electric oscillations or, as it is termed, a high frequency current. In order that this current may be rendered suitable for the purposes of electro-culture, however, its potential must be raised to a very much higher degree and the object of this article will be to explain the construction of the special type of transformer or coil employed in the process of stepping up the already high potential, high frequency current.

The high frequency transformer differs from the type used for the conversion of low frequency or commercial currents in that it has no core of iron and the turns in its primary and secondary are numbered in tens and hundreds, respectively, instead of in hundreds and thousands, as is the case with the transformer used for lighting and power work. Furthermore, on account of the extremely high potentials induced in the oscillation transformer, the insulation problem must be treated in a somewhat radical manner. This problem is not, however, so difficult of solution as it might seem. The coil may be of generous proportions, since close coupling of the primary and secondary winding is not essential, and the permissible air space affords a most effective insulator. While the efficiency of oil insulation in cases similar to the present one is not questioned for one moment, still the air insulation, if properly carried out, offers exceptional advantages over all other forms wherein the windings are hidden from view and are inaccessible. The latter method has accordingly been selected.

The transformer consists essentially of a primary winding of eight turns of copper strip placed at the base of a cylinder around which is wound the secondary of 300 turns of No. 30 D. C. C. copper magnet wire in a single layer. The starting point of the primary, as well as that of the secondary, is connected to a stud of metal which passes through the base of the instrument for ground connection. The primary of the coil is connected in the circuit of the condenser and spark gap in order that the oscillations may pass through the copper strip and thus induce a high frequency current of higher voltage in the secondary winding. The general appearance of the completed coil is shown in the illustrations, Fig. 1, and in Fig. 2 the reader will find details of the parts from which it is constructed, together with the dimensions of the various pieces.

*This article is one of a series dealing with various methods of electrical plant culture that has appeared in this publication since September, 1914. The various instalments have dealt with the different methods of applying electricity to horticulture, as well as described the construction of the apparatus required. Back numbers may be secured at 15 cents each while the supply lasts.

The secondary cylinder is of cardboard and made expressly for the purpose. In designing the coil, the writer has purposely chosen, wherever practicable, dimensions which correspond with the standard sizes of the parts now obtainable through electrical manufacturers. Accordingly, the cylinder has been made eight inches in diameter and 13 inches long. The wall is about one-fourth inch thick. Into each end of the cardboard cylinder is fitted tightly a head turned up from whitewood and soaked for an hour in melted paraffin. The heads are drilled for the terminal post and the brass stud, respectively. The details of the terminal are given in Fig. 2 but the stud has been omitted, since its construction is obvious. The next operation is to treat the cardboard cylinder to three coats of shellac, making certain that each coat is bone-dry before applying the next and baking the cylinder after each coat in a moderately warm oven.

With the third coat of shellac quite dry, the cylinder may be mounted in the lathe between centers, a slender screw driven into the wooden head and catching a slot in the faceplate to afford a means of driving. The lathe should then be speeded up and the surface of the cylinder carefully gone over with the finest sandpaper to remove the inevitable irregularities caused by particles of dust and dirt. On no account must emery paper or cloth be used and the lathe bed must be scrupulously clean while the cylinder is being handled, as the least trace of metal chip or dust under the winding would be fatal to good results.

The surface of the cylinder having been carefully smoothed over, the lathe may be prepared for the winding. The gears are set to cut 24 threads per inch and the winding of No. 30 D. C. C. wire is started one-fourth inch from the end. In starting, the wire should be passed through a small hole in the cylinder and the hole immediately plugged with a bit of wood covered with wet shellac. This will prevent the winding from coming loose during subsequent handling. The lathe should be turned slowly and backward, and the wire fed through a guide held in the tool post. When the finishing turn, the 300th, is in place, the final end

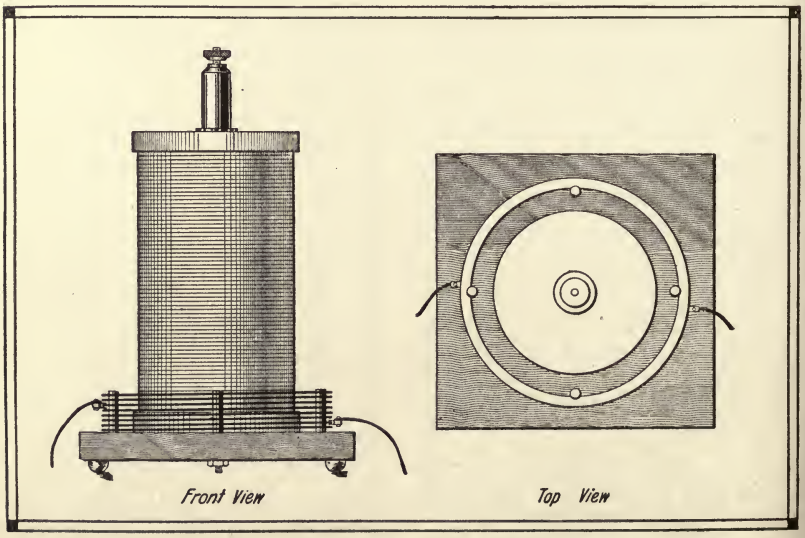


Fig. 1.—The High Frequency Coil for Plant Culture as it Appears when Completed.

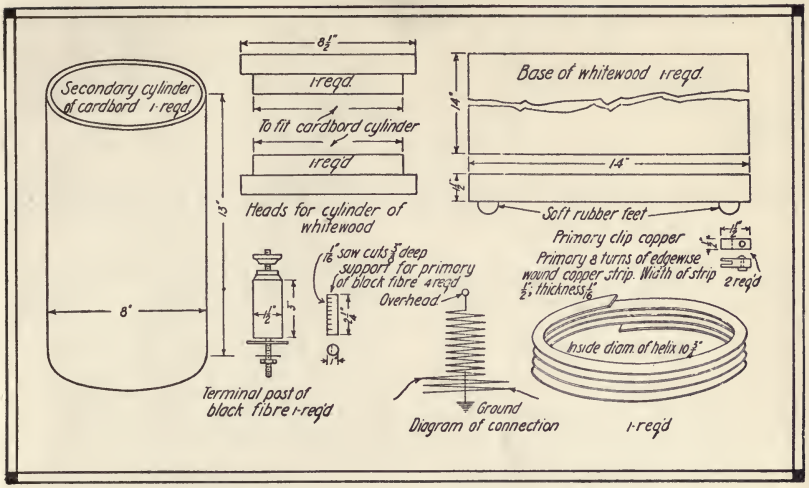


Fig. 2.—The Various Parts Required in the Construction of the High Frequency Coil.

of wire may be passed through the cylinder and secured as was the starting end.

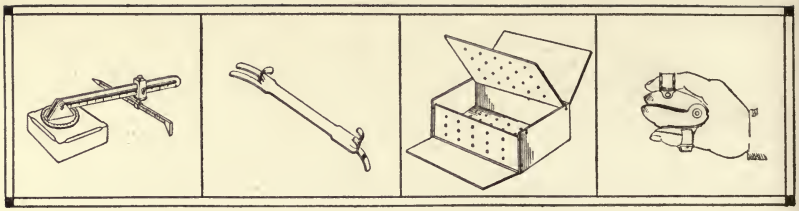
While the coil is still in the lathe, the winding should be coated with shellac applied in a thick solution and with a soft brush, the greatest of care being taken to see that the fluid soaks well into the turns and between them and also that no air bubbles or particles of dirt are permitted to remain. When the first coat has dried for an hour or more, the cylinder may be carefully removed and placed in the oven, wherein the temperature should not be over 150 degrees F. The baking may continue for a few hours and the second coat applied after the coil has been put back in the lathe. The builder is strongly advised to do all of the painting in the lathe, as the examination and turning of the cylinder is greatly facilitated thereby. The third coat may be the final one and it should be dried as thoroughly as the first and second.

The secondary finished, the wooden heads may be removed and connection made with the terminal and base studs. This is easily accomplished if the ends of the wire are left long and passed through the holes in the heads with the studs fitting loosely. When the heads are replaced, the wires may be drawn taut and the nuts of the studs turned up to grip the bare wire. The heads may then be secured in place by plugging with wood dipped in shellac, the small holes drilled around both top and bottom of the cylinder.

The base of the instrument is simple in construction, as is readily seen in the drawing. The method of supporting the primary strip, as well as the nature of the latter, will, however, bear some explanation. The copper strip is one-half inch wide and one-sixteenth inch thick and is wound edgewise into a helix having an internal diameter of 10¾ inches. This helix material is also to be obtained in the size given and it can be purchased far more cheaply than it can be formed up by the amateur workman unless he has the necessary equipment for the bending operation. As this device is quite complicated, the space necessary for its description will not be taken here. The problem is to bend the thin strip edgewise and prevent it from buckling.

Assuming that the builder has procured the helix material, eight complete turns of which are required, the attention may be directed to the posts which support the helix on the base and at the

(*Continued on page* 861)



Recent Novel Patents

A Surface Gauge

A New York inventor has just secured patent rights on a very novel design of surface gauge which is illustrated in one of the accompanying sketches. As will be noticed, it consists of a heavy block on which is pivoted a long arm. The arm may be set at any angle by means of the protractor. On this arm slides another arm. This device should prove very convenient in laying out work.

A Pot and Cover Lifter

An Austrian inventor has been granted a patent upon an ingenious pot and cover lifter, made from a strip of sheet metal. It is slotted at both ends, so that the fingers, which have been curved, will easily grasp pots and pans of various shapes.

Cigar-Box Humidor

A cigar-box consisting of two thicknesses of wood on the top, bottom and front, containing moistening pads between the two bottom layers, is the subject of a patent recently granted to a Florida inventor. The inner layers of wood are perforated so that the moisture from the pads can penetrate to the cigars.

A Fruit-Picker

A scissors-like fruit stem cutter which is adapted to fit the hand of the cutter has been patented by an inventor in California. The two blades of the cutter pivot at a point within the small of the hand, and they are held to the forefinger and thumb by small straps, so that they may be opened and closed readily.

A Coat and Vest Combined

The man who likes to work in his shirt sleeves and at the same time has no convenient place to hang his coat will be interested in a combination coat and vest upon which a patent has been granted to an Illinois inventor. The coat flap is made in combination with the vest flap. The coat flap has an inner pocket.

A Knife Sharpener

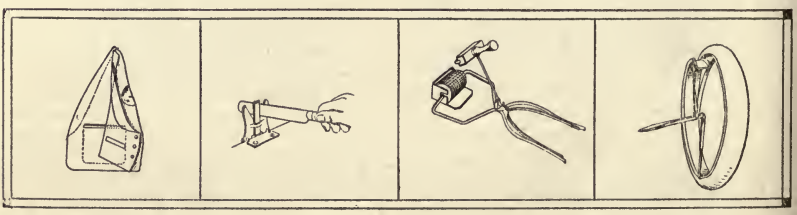
A knife sharpener of unusual design has been patented by a man in New York. It consists of a hinged plate which is screwed to a table edge or shelf, an upright plate, cut with a V-shaped notch, and a sharpening steel fixed upright in the wedge. The knife to be sharpened is drawn across the steel, the angle of the sharpened edge being controlled by the wedge.

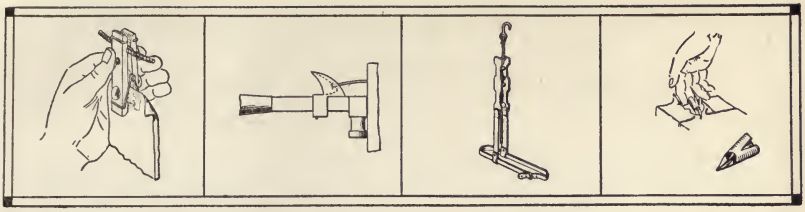
A Coin Wrapper

A new coin wrapper has been devised by a Chicagoan. It consists of a metal box, open on two sides, with slots at the ends. A clamping tool forces the coins together for wrapping, when its ends are inserted in these slots, and it removes them when the wrapping is completed.

Tool for Demounting Rims

Demountable rims and demounting tools for automobiles have been the subjects of countless patents. A new tool for this purpose, however, is unique in some of its features. A Connecticut man is its inventor. The tool consists of a lever arm to which is attached two arms of steel. These arms with the handle act as a double lever. The ends of the arms are bent to fit the edge of the rim. Depressing the lever pries one end of the rim downward, so that the tire can be removed.





A Spring Clothes-Pin

A clothes-pin, which is fitted with a spring so that it can be clamped upon the wire and the object to be suspended, has been patented by a New York inventor. A groove is cut in the upper end of the pin in order that the clothes-line will fit in it and be held tightly. The lower inner surface of the clamps is corrugated in the same way so that the article to be dried will not slip.

Ingenious Claw-Hammer

A claw-hammer which is provided with an adjustable claw that slides at the will of the operator, up and down the handle, has been patented by a California man. A locking pawl is fitted at the bottom of the slide, so that the claw may be locked in any position. This device will be found very convenient in removing nails of all lengths from wood. Sometimes a nail is protruding some distance and cannot be removed with the ordinary claw-hammer.

A Portable Fire Escape

A portable fire escape, which is to be attached to the body of the person making the escape, has been designed by a Maine inventor. A belt is provided at the lower end, which is intended to be passed around the body. A rope is hooked to the building and is passed through several metal pins set rather close together and the upper part of the contrivance. As the escaping person slides to safety sufficient friction is exerted by the pins against the rope to sufficiently retard the passage to the ground.

Twine Cutter for Finger

A small metal cap made to go on the finger and fitted with a sharp edge for cutting the twine on boxes is an ingenious little device recently patented. The tip is made flexible so that it will fit a variety of finger ends. The great advantage of this device is that it is constantly at hand. Much time is often wasted by clerks in hunting for a knife with which to cut the string of packages.

Sanitary Drinking Cup

A sanitary drinking cup, by means of which the faucet to which it is attached may be independently used, has been invented by an Oregonian. The cup comprises a bent tubular stem which is pivoted to a clamp attached to the faucet. When the cup is used the bent end of the stem is swung under the faucet; when the faucet is used, the cup is swung up out of the way on the same pivot.

A Swimming Machine

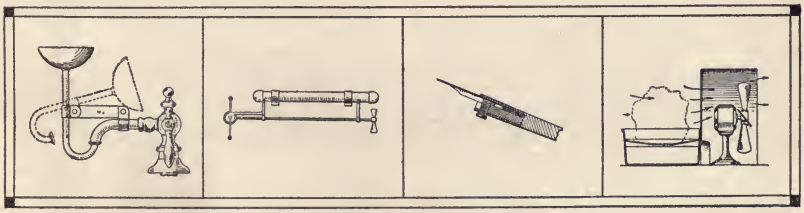
An ingenious swimming machine is the subject of a patent granted recently to a Colorado inventor. It consists of a number of floats to the bottom of one of which is connected a small propeller and a driving gear. A swimming device of this kind makes it possible for anyone to cover long distances in the water with the minimum of fatigue and at far greater speed than by ordinary means.

Set Screw Holds Pen in Place

To vary the monotony of the ordinary type of pen, an inventor in Oregon has brought out a somewhat complicated pen clamping device. The end of the penholder, which is hollow, is fitted with a plug in which is placed a spiral spring. The pen point is inserted so that it forces against this spring, and can therefore be adjusted. A thumb screw, set at right angles, passes through the end of the pen holder and clamps the point in place.

Fan Cools Air by Ice

The combination of an electric fan, a protecting shield for the blades and a pan to hold a block of ice is the subject of a patent recently issued to a man in Iowa. The ice is placed in the receptacle behind the fan and shield. The fan, revolving, draws warm air over the ice, cools it and projects it out into the room.



BOOK REVIEWS

A Telephone Handbook

While there are many telephone reference works available at present, the latest contribution of David Penn Moreton, entitled *Drake's Telephone Handbook*,* fills an important want. It is in the nature of a handbook, and as such it covers the subject in a concise, practical and handy manner. The author does not give lengthy and overdrawn discourses on electrical and magnetic principles, but instead he introduces the subject proper to the reader with the least amount of preliminary discussion. It is assumed that the reader has a good fundamental knowledge of electricity in general and wishes to use Mr. Moreton's work as a pocket reference book.

* *Drake's Telephone Handbook*, by David Penn Moreton, E.E., B.S. Published by Frederick J. Drake & Co., Chicago, Ill. Contains 286 pages and over 160 illustrations. Cloth bound. Pocket size. Price, $1.00.

Electrical Measurements

A handy reference work for those interested in electrical measuring instruments and their uses has recently been published under the title of *Electrical Measurements*.* The commendable feature of this work is that the authors have taken it for granted that the readers have a good basic knowledge of electricity, and, as a result, it opens without loss of time or space to the subject under discussion. The authors appear to have covered the subject in a thorough manner, and, what is more, they have devoted a goodly part of the work to recording watt-hour meters.

* *Electrical Measurements*, by Bushnell and Turnbull. Published by the American Technical Society, Chicago, Ill. Contains 170 pages and 139 illustrations. Cloth bound. Price, $1.00.

Electro-Chemistry and Welding

Intensely interesting subjects are electro-chemistry and welding, and it is doubtful if they could be covered in a more comprehensive and entertaining way than in the work of Messrs. Burgess and Cravens entitled, *Applied Electrochemistry and Welding*.* In truth, the book is really two separate works: the first, dealing with electro-chemistry, has been prepared by Charles E. Burgess and deals with all that is worth knowing regarding this fruitful field of electrical application; the second, prepared by George W. Cravens, discusses at length the various methods of welding, both ancient and modern. In connection with the latter portion of the book, the sections dealing with Thermit and electric welding are of particular interest.

* *Applied Electrochemistry and Welding*, by Burgess and Cravens. Published by the American Technical Society, Chicago, Ill. Contains 132 pages and is profusely illustrated. Cloth bound. Price, $1.50.

A New Wireless Book

What is beyond doubt an innovation in wireless books is the recent work entitled, *A Wireless Receiving Set for Time Signals*.* It is evident that its author has endeavored to describe in the simplest and most comprehensive manner how to build a wireless set for receiving Government time signals. While primarily intended for jewelers and watchmakers, this book should be of almost equal interest to the beginner in wireless telegraphy, or the amateur who desires to build a long-distance receiving set at a small outlay for materials. It enjoys the distinction of being one of the few books that really describe the construction of the different pieces of apparatus in a complete manner, leaving nothing to the reader's imagination.

* *A Wireless Receiving Set for Time Signals*. Published by C. Brandes, Inc., 32 Union Sq., New York City. Contains 32 pages, 15 illustrations and a code chart. Durable paper cover. Price, 25 cents.

An Electrical Book for the Beginner

To the reviewer of the books in these columns there is a particular and personal interest attached to the work entitled, *Practical Lessons in Electricity*,* by Millikan, Crocker and Mills. It is quite some years ago now that he received a copy of an earlier edition of the same work and spent many an hour diligently studying and learning by its aid the elementary principles of electricity and electrical machinery. The present edition incorporates several minor changes that have been necessitated by improvements in electrical machinery during late years, although in the main it is much the same as the earlier editions, indicating that the work has been popularly received. While much could be said regarding *Practical Lessons in Electricity*, briefness compels these points only to be mentioned: It covers the important principles of electricity in a concise manner; important electrical devices, such as the telephone, dynamo, motor, batteries, storage batteries and the telegraph are touched upon; and, in a word, it may be added in conclusion that the book is unhesitatingly recommended to the layman desirous of securing a fundamental knowledge in electricity.

* *Practical Lessons in Electricity*, by Millikan, Crocker and Mills. Published by the American Technical Society, Chicago, Ill. Contains 318 pages and is profusely illustrated. Cloth bound. Price, $1.50.

Questions and Answers

This department will appear regularly in THE WORLD'S ADVANCE, subject to following regulations: The questions must be legibly written with typewriter or in ink, on one side of the sheet. Each question must be definite and cover but one point of the subject under consideration, although a letter can contain more than one question. On the 10th of the second month preceding the date of issue of the magazine, all the questions on hand will be considered and those which are put in the most intelligent manner and of widest general interest will be selected for publication in such issue, the number being governed by the space available. All other questions will be returned to the writers with a statement of the price for which they will be answered by letter. Return postage must be enclosed with each letter containing questions, and the letters must be addressed to the Questions and Answers Department and contain nothing relative to other departments of the magazine.

WEATHER BULLETINS.

Although we have at various times explained the meaning of the code used by Arlington and Key West in sending the weather bulletins at 10 P. M., we still receive many inquiries as to their meaning. We will, therefore, attempt to cover all of the many inquiries by the following explanation:

The bulletin is preceded by the letters USWB, meaning U. S. weather bulletin. Then follows a series of characters thus, S99131, T00618, etc. The letter stands for the place at which the observations were recorded. These stations are S-Sidney, T-Nantucket, DB-Delaware Bay, H-Hatteras, C-Charleston, B-Bermuda, K-Key West, P-Pensacola, for the Atlantic group; and DU-Duluth, M-Marquette, U-Sault St. Marie, G-Green Bay; CH-Chicago, L-Alpena, D-Detroit, V-Cleveland, and F-Buffalo, for the Great Lakes group. The first three numbers indicate the barometer reading. The first figure of the barometer is omitted; for it is known that if the first figure of the bulletin is an 8 or 9 the omitted first figure of the barometer reading was a 2. If the first figure in the bulletin is other than an 8 or 9 the omitted figure was a 3. Thus in the above illustration the barometer was, Sidney 29.91 and Nantucket 30.06. The fourth figure in the bulletin is the direction of the wind. The compass is divided into 8 parts, each designated with a number, north being 1, northeast 2, etc. The last figure is the velocity of the wind in the Beaufort scale. The complete translation of the above example is, then, Sidney, barometer 29.91, wind east three miles, Nantucket, barometer 30.06, wind north forty miles. The observations are taken at 8 in the evening.

DYNAMO DATA.

(35) W. F., Des Moines, Ia., asks:

Q. 1.—Will the following design and dimensions be suitable for making a dynamo for 50 volts and 10 amperes? Upright field magnet (Thomson-Houston type) with cast-iron magnet cores, 2½" dia., 2" long. Armature core 2¾" dia., 2¾" long, with 16 slots, each ¼" x ⅜". A speed of 2000 rev. is preferred. If possible, Nos. 17, 18, 21 and 23 wire should be worked in, for a considerable quantity of those sizes are on hand.

A. 1.—Using a size of wire to permit an output of 10 amperes, you can get on only enough turns to produce about 20 volts. You will need to increase the dimensions of all parts about 20 per cent. The proportions are good. For your guidance we would refer you to Watson's "How to build a ¼ h. p. Dynamo," and "How to build a ½ h. p. Dynamo," but will be pleased to advise you further, if you desire it.

MOTOR PROBLEMS AND AUTOMOBILES.

(36) A. S., Chicago, Ill., asks:

Q. 1.—What horsepower of alternating current motor would be required to drive a 5 k.w. 110-volt direct current generator?

A. 1—About 7 or 8 h.p.

Q. 2—How many minutes does it require for a generator to "build up" to the point at which it would be suitable to start a 5 h.p. motor?

A. 2.—About 10 to 30 seconds is supposed to be allowed for starting a motor of the size you mention, and the generator ought to have its field magnet well established in the same time. Evidently you have some particular application of electric power, and we advise you to consult the engineering authorities at the offices of some of the manufacturing companies, General Electric, Westinghouse, Allis-Chalmers, etc. They have apparatus to sell and are very free with reliable advice

Q. 3.—Does it require the same horsepower to drive an electric car as a gasoline car?

A. 3.—Under the same conditions, yes, but in consequence of the gasoline engine having very small overload capacity, as compared with an electric motor, the former must be built powerful enough to supply the maximum re-

quirements. For this reason it may not work at as high an efficiency at ordinary loads as desirable.

CONNECTIONS FOR TRANSFORMERS.

(37) E. H., Placerville, Idaho, asks:

Q. 1.—How to connect three transformers in such a manner as to change a primary voltage of 19,000, three-phase, to 440 volts, two-phase?

A. 1.—This cannot be done with three transformers, but with two, connected on the "Scott" or "T" plan, it can be accomplished. For this purpose you need transformers having primary coils wound in two sections, each for 9,500 volts, which can be coupled in series, also having taps brought out at the 16,400 volt points. Secondaries are both alike, being for 440 volts. Connect No. 1 transformer primaries in series and having this middle point connected to one terminal of No. 2 transformer. The two terminals from No. 1 and the special tap from No. 2 will give the three to which the line wires connect. The four secondary wires will permit connections of two-phase order.

REWINDING A MOTOR INTO A GENERATOR.

(38) J. G. E., Phillipsburg, N. J., asks:

Q. 1.—What should be the new winding for a 220-volt ½ h.p., 2,150-rev. direct current motor to permit its use as a 30-volt 30-ampere generator, at a lower speed? It has a shuttle armature and 42-segment commutator.

A. 1.—To get the ½ h.p. you probably would have put in about 2.75 amperes, or about 600 watts To ask for an output of 900 volts, and that, too, at a reduction of speed, will clearly be impossible. You can get about 20 amperes at 30 volts by rewinding the machine with wire six numbers larger than at present. We suppose you meant a toothed drum armature rather than "shuttle," for this would permit but two commutator segments.

REWINDING A MAGNETO.

(39) H. B., San Francisco, Cal., asks:

Q. 1.—Can a 3-bar telephone magneto generator be rewound so as to give 6 volts and 1½ amperes, direct current, a 2-segment commutator being used?

A. 1.—Yes, but you will get more satisfactory results if you adopt a 6-slot laminated drum armature and a 6-segment commutator. Especially for operating ignition apparatus the shuttle armature will be irregular.

INDUCTANCE FORMULÆ.

(40) Roy Hustor, Toronto, asks:

Q. 1.—Can the formula—

$$L=\frac{(5 \times D \times T)^2}{1000\ (1/3\ D + 3/2\ M + 5/4\ N)}$$

where L is inductance in microhenrys, D average diameter in inches, N depth of winding in inches, T number of turns, M length of coil in inches, be applied to a single layer coil of a loose-coupler, or to a doughnut coil such as is used in variometers?

A. 1.—The above formula applies to the doughnut type of coil. That is, to a coil of more than one layer and whose length is small compared with its diameter. For a single layer coil such as the ordinary tuning coil the formula simplifies to—

$$L=\frac{(5 \times D \times T)^2}{1000\ (M + 1/3\ D)}$$

Of course, it is to be understood that these formulæ are only for the self inductance and moreover are only approximations. A good treatise on self and mutual inductance is found in Reprint No. 93, "Formulæ and Tables For the Calculation of Mutual and Self Inductance." This bulletin may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for thirty cents. It contains many formulæ and explains the cases to which each applies. It is a book well worth having. Fleming, in his "Principles of Electric Wave Telegraphy and Telephony," explains several formulæ for calculating inductance for high frequency currents.

CHANGING A MOTOR INTO A GENERATOR.

(41) C. E. H., Deerfield, N. Y., asks:

Q. 1.—Can a ⅛ h.p. 500-volt .4-ampere motor—Crocker-Wheeler, type S—be rewound so as to give an output as a generator of 10 volts and 8 amperes? It has a laminated armature with 8 slots and a commutator of 16 segments.

A. 1.—The figures you have indicated allow for a motor input of 200 watts, so you ought readily to obtain the 80 watts from use of the machine as a generator. Perhaps you prefer to drive the armature at a lower speed. It would appear that the present field winding might be of the series rather than of the shunt type, in which case you may possibly be able to utilize it merely by connecting the two coils in parallel with each other rather than as at present in series. At any rate, it would be well first to rewind the armature, then to try the machine. You will require only about one-fortieth as many turns of wire, you can therefore use wire of 40 times the size. For instance, if the present wire is No 30, you could use No. 16, double cotton covered. Wind a given slot and its opposite one-quarter full, bring out a loop, then wind it and its opposite one-half full, and bring out a second loop. Then do the same in the next slot and its opposite. You will thereby get 16 loops for attachment to the commutator. If you have to rewind the field magnets, use No. 19 or 20, single cotton covered.

RADIO SECTION

Devoted to the Encouragement of Amateurs and Experimenters in the Field of Radio Communication.

Lightning Protection

By A. S. Blatterman, B. S.

IT is generally recognized that a lightning discharge is oscillatory and that the oscillations are of high frequency, perhaps from 100,000 to several million cycles per second. At these high frequencies the electric constants of conductors are very different from those normally. In the passing of high-frequency currents, energy is expended in two ways, as heat at the surface of the conductor and in electromagnetic radiation into surrounding space. In the case of an ordinary lightning rod, the resistance, which depends on the material and cross-section of the rod, is of little importance; even the shape of the conductor, which is of much importance with frequencies from 100 to 100,000 cycles per second, is of relatively little importance at frequencies from a million to ten million cycles. It is evident from this that, provided a lightning discharge is oscillatory, it matters very little whether copper or iron, flat or round, stranded or solid conductors are used, though, to be sure, there is some advantage in flat ribbons at all but the highest frequencies. One object of a lightning rod is to form a path for the discharge, a path offering much less obstruction than any path through the structure to be protected. If the *resistance* were all important, this could well be done by using a very large copper rod, but at these very high frequencies the *impedance* is measured in tens or even hundreds of ohms, whereas the resistance may be but a small fraction of an ohm. Thus the inductance of the rod at these high frequencies is of great importance.

Lightning discharges from cloud to earth undoubtedly take place, not only at moderate voltages, but also at voltages which are extremely high, the latter being the case when the charged cloud is separated from earth by a layer of more or less dry air. Under these conditions the distribution of potential may be quite uniform and the air may, as a limiting case, be charged to its breakdown point all through its mass, when the p.d. may be great, perhaps hundreds of millions of volts. The maximum value of the discharge current may also be very great, reaching thousands, if not hundreds of thousands, of amperes. Such enormous currents passing through a conductor at high frequency give rise to exceedingly high potential drops along the conductor, and for this reason a lightning discharge

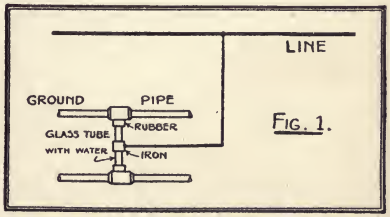


FIG. 1.

Method of Grounding a Line in Order to Remove Static Charges.

would frequently rather jump several feet in air than travel one foot in the conductor. Sharp bends should be avoided.

For the protection of transmission lines the lightning rod is usually a horizontal wire or a couple of wires carried along the towers above the line and grounded. Such construction brings ground, or zero, potential up to a point above the transmission line and thereby lowers the electrostatic potential of the space in which the transmission line is located. The ground wire also protects the stations along the line in case a direct stroke of lightning reaches the line, by its damping effect as a secondary grounded conductor.

Inasmuch, however, as a system of overhead ground wires cannot be a complete enclosing shell of perfect conductivity its protective effect, however great, cannot be quite complete; therefore, protective devices have to be installed at the stations as safeguards against the entrance of lightning from the line.

Station protection differs somewhat from the ordinary protection of buildings. As far as safeguarding buildings is concerned, there are to be considered either the direct lightning stroke, or else the secondary discharge caused by a violent primary discharge in the neighborhood. But in the case of the transmission line, where station damage is due largely to surges which are characterized by the electrical constants of the line, it is not simply a matter of conducting a lightning stroke safely to earth.

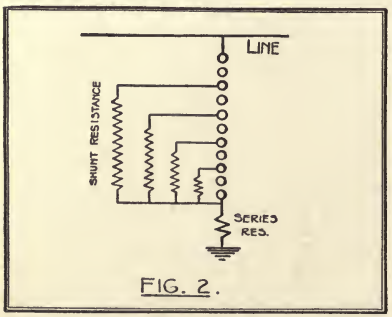


FIG. 2.

Connections for a Multigap Arrester with Shunt Resistances.

It is true, as regards sudden versus sluggish lightning discharges, that the sudden variety is most dangerous. Even the slow accumulation of charge on a line, which is called the static charge, is a series of spits, as can be shown by connecting a telephone to a suspended aerial conductor; but such accumulation can be taken care of by grounding through a high resistance. (See Fig. 1.)

When a pure electric wave containing equal amounts of electric and magnetic energy is created on a transmission line by a lightning discharge, the energy of the wave is dissipated with a minimum of surging of current if the two wires be connected at the end of the line by a non-inductive resistance of which the value is $\sqrt{\frac{L}{C}}$ where L and C are respectively the inductance and capacity of the line. This is evident because a resistance of value $R = \sqrt{\frac{L}{C}}$ does not reflect any portion of a wave, but swallows up its energy completely.

In Fig. 2 is shown the connections of a multigap arrester with shunt resistances. Such an arrester automatically inserts a low resistance or a high resistance between the line wires, according as the energy to be dissipated is large or small. The action of the arrester is as follows:

The arrival at the end of the line of a traveling wave from the point of lightning stroke causes the voltage to rise to an excessive value. Consider the arrangement shown in Fig. 3. The point p is at ground potential so that the series gaps break down first, and this throws the line potential directly across the shunted gaps and the shunt resistance. Generally the shunted gaps will now break down; but if the various parts are properly proportioned the shunt resistance will take so much current from the shunted gaps that the arcs in these gaps will drop out. Once the arc drops out of the shunted gaps it must pass through both series and shunt resist-

ances, which will reduce the current strength so much that the series gaps can suppress it altogether. The use of the series resistance is found necessary for the successful operation of the above to prevent enormous rushes of current. It is in general an objectionable feature, but, if small, it is practically harmless. The use of the shunt resistance allows the series resistance to be kept comparatively small.

From the standpoint of lightning protection an interesting feature may be observed in the construction of the line itself, namely, to so design the transmission line as to realize the condition of the distortionless circuit, so that any wave starting out from the place of lightning discharge would retain an unimpaired abruptness at its front, and thus be of a character to be easily arrested by a choke coil and deflected to earth through a spark gap.

When the resistance per unit length of a line (counting both lines) is related to the leakage resistance between unit length of the wires in such a way as to cause an equal decay of the electric and magnetic fields in a wave (so that $\frac{1}{2}LI^2 = \frac{1}{2}CV^2$ at all times) then the wave travels along without distortion.

Referring to Fig. 4, we represent the resistance per unit length of the circuit by R_w, and the inductance and capacity respectively by L and C. The current at the point considered is I, and the p.d. between wires is E. The leakage resistance between unit length of the wires is R_1. We have,

Loss due to wire res. $= 2R_wI^2$

Loss due to leakage $= E^2/R_1$

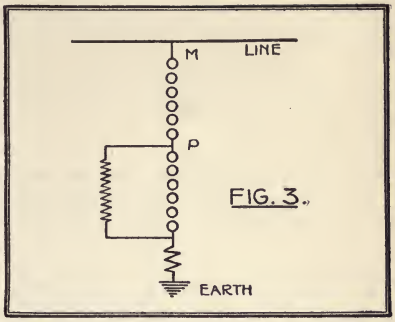
The condition for no distortion is that these two losses be constantly equal.

$$2R_wI^2 = \frac{E^2}{R_1}$$

Solving for R_w, and using the well-known relation $E^2/I^2 = L/C$,

$$R_w = \frac{L}{2C} \times \frac{1}{R_1}$$

In the usual transmission line R_w is so large that this equation does not hold, and hence, to obtain the distortionless condition, it may be of advantage to lower R_1, *i. e.*, to provide high-resistance leakage paths to earth from the line, or from wire to wire of the line. A traveling wave would then retain its steep front and be the more readily stopped by the choke coils at stations and thence conveyed to earth through the spark gap arresters. Fig. 5 shows the arrangement of appliances at stations along a transmission line for protection against lightning.



Another Form of Multigap Arrester for Removing Static Electricity from a Line.

In regard to the non-arcing power of the gaps in the multi-gap arrester, some of the influencing factors are:

1. Material of gaps.
2. Length of gap.
3. Temperature of gap.
4. Short-circuit current through gap.
5. Inductance in circuit.
6. Frequency.
7. Phase of e.m.f. at time of discharge.
8. Shunt resistance.

The character of the metal forming the electrodes of the gap is very important, as is also the length and temperature of the gap. Those metals which have the greatest non-arcing power are zinc, bismuth, antimony, cadmium. Brass, an alloy of zinc and copper, also posseses non-arcing characteristics, and, in general, the addition of zinc to a metal or alloy renders it non-arcing.

With gaps 1/64″ to 1/16″ the non-arcing power varies somewhat less than proportionally to the length of the individual gaps. It is a peculiar fact that while n sparks in series require the same voltage as (in some cases very much *less* voltage than) one spark n times as long, n *arcs* in

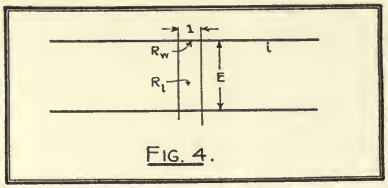


FIG. 4.

Diagram to Illustrate Various Mathematical Calculations in Connection with Lightning Arresters.

series require nearly *n* times the voltage of a single *arc* *n* times as long. Hence, the greater the number of the spark gaps, and the shorter, therefore, their length, the more favorable is the relation of arc voltage to spark voltage.

A great increase in temperature reduces the non-arcing power of the gaps. The heavier the short-circuit current through the gaps the more heat is liberated, and hence the non-arcing power drops off with increased short-circuit current; and, as the heating varies as I^2 the non-arcing power follows nearly a square law with respect to current.

The amount of inductance in circuit is another important factor, its presence tending to prolong the arc. The effect is very noticeable in an electric spark where arcing exists. Addition of inductance changes the white, sharp crackling discharge to one more violet in color and of a weaker, mushy sound.

Frequency, at least between 25 and 60 cycles, has little effect on non-arcing power. The length of a single alternation is, of course, greater at the lower frequency so that more heat units are developed before the zero point of the wave is reached. On the other hand, the duration of the period of small current is longer, which has a compensating effect.

The laws determining when the shunt resistance will be able to draw sufficient current to cause the arc to drop out in the shunted gaps are as follows, and are taken from a paper by P. H. Thomas which appeared in the Proc. A. I. E. E. (The shunting power is measured by the greatest number of ohms per shunted gap allowable in the resistance.)

1. *Number of Shunted Gaps.*—The amount of shunt resistance which will allow these gaps to be non-arcing varies directly as the number of these gaps.

2. *Short-Circuit Current.*—The number of ohms allowable per shunted gap varies approximately as the square of the current through the shunted gaps following the static discharge.

3. *Power Factor.*—The number of ohms allowable varies slightly with the power factor of the current following the static discharge.

4. *Ratio of Series to Shunted Gaps.*—The best ratio of the number of series gaps to the number of shunted gaps seems to be unity, *i. e.*, half the total number of gaps should be shunted.

In regard to the action of the lightning conductor in connection with the protection of buildings, this is regarded as an illustration of the action of induction and of the property of sharp points; when a storm cloud positively electrified, for instance, forms in the atmosphere, it acts inductively on the earth, producing a negative charge on bodies placed on the surface, the larger as these bodies are at a greater height. The density is then greatest on the highest bodies, which are therefore most exposed to the electric discharge; but if these bodies are provided with metal points, like the rods of conductors, the negative electricity flows into the atmosphere and neutralizes the positive electricity of the cloud. Hence, the action of the lightning conductor is two-fold; not only does it tend to prevent the accumulation of electricity on the surface of the earth, but it also tends

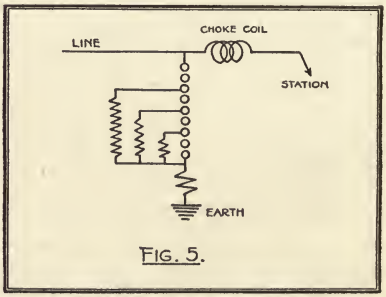


FIG. 5.

Arrangement of Lightning Arresters at a Power House.

to restore the clouds to their normal state, both of which concur in preventing lightning discharges. If the quantity of electricity is, however, so abundant that the lightning conductor is inadequate to discharge the electricity accumulated, then the lightning strikes; but the conductor receives the discharge, in consequence of the greater conductivity, and the edifice is preserved.

WIRELESS TRANSMISSION OF POWER

NOT only trains, but steamships and trolley cars may be operated some day by means of an "Energy Path" instead of a visible transmitting medium. The idea is not new, as it was advocated by Nicola Tesla years ago, and became the basis of a patent for transmitting energy without wires on a large scale. At present, by wireless, the power is radiated in many directions without concentration. It does not follow a definite path. This is because the energy is sent into a non-conducting medium, the ether. In a non-conducting body, electricity is found at rest, therefore it is called static. When it is in locomotion, as Sir Oliver Lodge terms it, it appears as current electricity. Conductors then carry it, or fluids or even non-conducting bodies, when it is forced through the latter. When electricity is made to rotate or set up whirls in the ether, magnetism is created. By means of magnetism motors and dynamos produce mechanical power and electricity, respectively. But the motor must have the electricity conducted to it by means of metal paths. The dynamo is attached to metal circuits, by means of which the electricity is transmitted to points of consumption. When brought to a certain point, if a motor is attached there, the electricity is forced to produce mechanical power, through its ability to create magnetism or etheric whirls. If transmitted to another point it may be forced to produce vibration or intense radiation, called light and heat. Light means electricity forced to produce visible vibrations. Heat for warmth or cooking is generally an invisible type of ether wave. One is short, the other long. The whiter the light the shorter the wave, up to a certain point. The ether wave used in wireless telegraphy is very long in comparison. It does not carry much energy in any particular direction at present. That is why it is only used for delicate signalling, such as wireless telegraphy and telephony. For the delivery of greater quantities of power, more concentration would be necessary or an entirely different wave.

Electricity, according to Sir Oliver Lodge, Clerk Maxwell and Lord Kelvin, is supposed to be a fluid of perfect incompressibility—in other words—a perfect liquid, extending everywhere and permeating everything. In a conducting material this liquid is capable of free locomotion while in *insulators* and *general space*, it is, as it were, entangled in some elastic medium or jelly—to strains in which electrostatic actions are due. This medium might be burst in a disruptive discharge (lightning or sparks) but an easy flow can go on only through channels or holes in it called conductors. The locomotion of current takes place in electric lighting, when motors are operated, or when heat is produced. Otherwise electricity produces rotation of the ether or magnetism or vibration and radiation, causing the many effects of visible or invisible light. Therefore the phrase "locomotion of electricity" is employed to distinguish between its rotation or vibration.

Sir Oliver Lodge states as his belief that positive and negative electricity together make up the ether. To quote his words, "the ether may be sheared by electro motive forces into what would become positive and negative electricity if they were really separated. A continuous shearing force applied to the ether in metals produces a conduction current." This we are all familiar with in the industrial use of electricity. We cannot affect

the ether directly at all. Indirectly it is affected by the ether bound up in matter, which thus affects it. In a conductor the bound ether is not rigid. In an insulator it is resilient, when displaced, it springs back again. In space, electricity exists, as it does in conductor or matter. It must be sheared, to produce the separation resulting in two streams of positive and negative, as in a conductor. To shear it, electromotive forces, electric pressures, are required. When a method is discovered, electric energy will be sent over long distances for industrial purposes, without wires.—NEWTON HARRISON, E. E.

THE COLORADO WIRELESS ASSOCIATION

At a recent meeting of the Colorado Wireless Association of Denver, Colo., the following officers were elected: President, W. S. Lapham; Vice-President, H. O. Whitman; Secretary, Ernest Anderson; Treasurer, E. S. Stockman; Chief Operator, W. H. Smith.

With the help of the Instruction Department of the Y. M. C. A., the officers of the Association have mapped out a complete course in the theory and practice of a modern wireless station, and expect all members to be expert operators when they finish the course. The course is free to all members.

The Association has at the present time many enthusiastic members, which accounts largely for the success it has enjoyed. At present, the permanent quarters of the Association are on the top floor of the Y. M. C. A. Building. On the roof of the building an aerial has been erected measuring 400 feet long, with an average height of 150 feet. Each member has donated some piece of apparatus and the complete set is claimed to be one of the best in that section of the country. On several occasions members have heard HU (Kahuku, Hawaiian Islands), a distance of about 4,000 miles; and KET (Bolinos, Cal.), and NAA (Arlington, Va.), in mid-day. At night the station has worked with 9XN (University of North Dakota), 70H (Le Grande, Ore.), and other amateurs at less distance. The receiving records have been made with a galena detector.

The Colorado Wireless Association will be pleased to hear from amateurs and other clubs in their section of the country, either by wireless or by mail. Correspondence should be addressed to the President, W. S. Lapham, 1545 Milwaukee St, or the Vice-President, H. O. Whitman, 2252 Washington Ave., both of Denver, Colo. The wireless call letters are CWA.

TRANSPARENCY OF METALS

It has been known for years that thin sheets of gold and silver, mounted on glass, may be made transparent by heat; but it is only within recent years that serious study has been given to the conditions under which such transparency may be obtained.

It is said that a sheet of gold one three-hundred-thousandth of an inch thick becomes transparent when heated to 550 degrees Centigrade. The transparency is ascribed to the gold aggregating and allowing white light to pass through the interstices.

With silver one-hundred-and-twenty-thousandths of an inch thick no transparency is produced so long as the atmosphere is a "reducing" one, such as hydrogen or coal-gas. But in the air the transparency begins at 240 degrees and is remarkably complete at 390 degrees.

Copper one-seventy-five-thousandth of an inch thick does not become transparent in a reducing atmosphere, but in air it is transparent between about 200 degrees and 400 degrees. At the lower temperature the light is a brilliant green, but as the temperature rises oxidation takes place, and the color ranges through olive and dark red to black.

Rotary Spark Gap Efficiency

By Charles L. Whitney

OCCASIONALLY one may hear an amateur station using a new rotary gap, which, strange as it may seem, does not come in louder nor does it carry further than the straight gap that was being used before in that particular station. Of course, the spark may be of a very pleasing tone, but after all the carrying power is the prime factor to be considered. Why is it that the rotary gap does not increase the sending radius?

The main reason why many amateurs are not securing greater transmitting range with a rotary gap than with a straight gap is due to the fact that they are having too many spark discharges per second. The transmitting condenser in most cases does not have the opportunity to become fully charged in the period when the gap is not sparking. While the condenser might be reduced in size so as to become fully charged, the disadvantage then would be that the full power of the transmitter would not be utilized. The only satisfactory alternative is to reduce the number of discharges so that there will be one spark for every alternation of the current. This may be accomplished by the use of a synchronous gap.

As there are few amateurs who are using a motor-generator set in conjunction with their sets, it is impractical for them to use a gap, made synchronous by mounting it on the shaft of the generator itself. A satisfactory substitute for this form of synchronous gap is a non-synchronous gap operating at such a speed as to make it synchronous with the alternating current supply. As for example, suppose a motor used to operate a gap has a speed of 1800 revolutions per minute. If the rotating disc has four plugs, the number of discharges per second will then be $\frac{1800 \times 4}{60} = 120$ sparks. Thus by using a 60 cycle current for the transformer and a rotating discharger with four plugs on the disc, operating at a speed of 1800 revolutions per minute, the spark will be synchronous with the current. As it is next to impossible to have the motor speed remain exactly constant at all times, the spark will waver very slightly. This latter feature, however, will give the spark a pleasing tone. The best motor to use for the purpose is one in which the speed can be varied by the use of a variable resistance of about 500 ohms, placed in series with the line. This resistance may be placed within convenient reach of the operator.

It is advisable to use a motor that has a speed of at least 200 revolutions per minute more than that which will be required for the rotary gap, since the speed can be regulated more readily if the frequency of the alternating current should run slightly over its rating. For instance: Supposing the line frequency should be raised to 62 cycles, the voltage remaining the same. The rotary gap would then be obliged to discharge at the rate of 124 sparks per second in order to be in synchronism with the current frequency.

The table that follows indicates the correct number of plugs to use on a rotary disc for different motor speeds:

Speed.	Plugs (60 cycles)	Plugs (120 cycles)
1000 R.P.M.....	8	16
1200 "	6	12
1800 "	4	8
2400 "	3	6
3600 "	2	4

When using an odd number of plugs for speeds between 2400 and 3600 revolutions per minute the plugs are placed at equal distances apart around the disc and the stationary electrodes are so arranged as to come opposite two of the rotating plugs at the same time. An odd number of plugs is no drawback if the gap is properly constructed.

The data given in the foregoing permits of the use of the correct con-

denser capacity with any transformer.

A rotary gap of the set on board the U. S. transport "City of Memphis," stationed in Mexican waters during the recent trouble in Mexico, enabled distances of 400 to 500 miles to be covered in daylight with one kilowatt of power. This was due to the fact that the gap was properly designed to conform with the current supply frequency. Before that time a rotary gap with ten plugs was used and the maximum daylight radius never exceeded 300 miles, since the current supply was 60 cycles and the speed of the gap 2400 revolutions per minute.—CHARLES L. WHITNEY.

GOVERNMENT RESEARCH IN ELIMINATING ELECTROLYSIS

HOW to prevent expensive damage to the pipes and cables of water, gas and telephone companies by roving electric currents from street railways is a problem toward the solution of which Uncle Sam has made important strides recently. The problem arises from the tendency of negative return currents from street railways of overhead trolley construction to leave the rails and find their way back to the power house over such available metal pathways as underground pipes. Where the currents leave the pipes and find their way back to the power house through some direct conductor, they set up what is known as electrolysis. The effect of electrolysis is to cause corrosion of water pipes, which results in time in serious leakage.

Experiments with methods of mitigating the evil are being pushed by the United States Bureau of Standards, and surveys have been made of conditions in various cities.

The electrolysis situation in all cities having modern traction facilities is sharply felt by the owners of the injured pipes and cables, but at first sight it does not seem seriously to affect the railway companies, if they take only a selfish point of view. Most of the surveys of the Bureau of Standards have been made at the request of the suffering utilities, but marked success has been had in winning the approval and cooperation of the railway companies.

In several instances it has been found that the traction companies can bring about a sufficient saving of current, by following the recommendations of the bureau's experts, to make the course worth their while. It is also coming to be recognized by many companies that the taking of steps to minimize the ravages of electrolysis is advantageous in order to escape damage suits and drastic legislation which may stipulate that the defects be remedied in a more expensive way than is necessary.

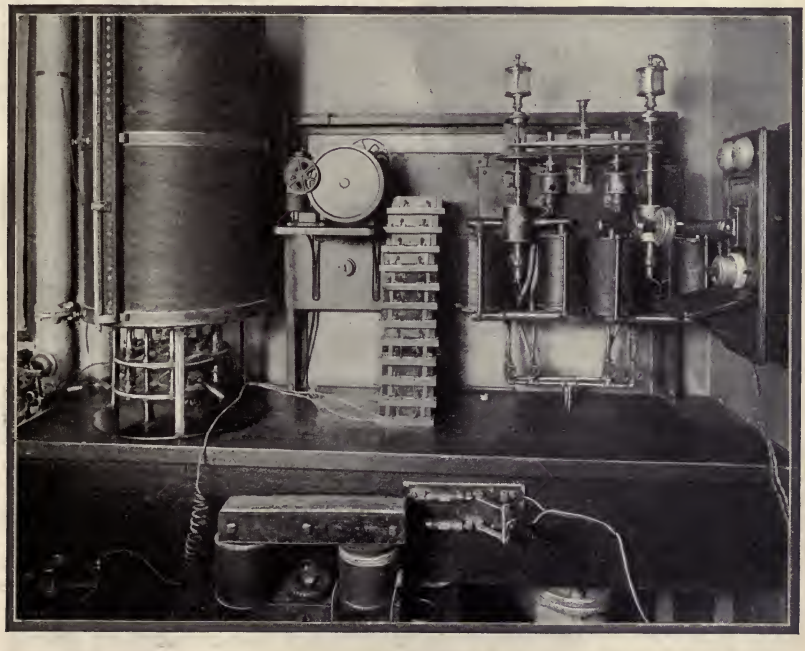
In exceptional cases only does the bureau advise the use of "pipe drainage" systems—the tapping of current from pipes by methods which prevent corrosion. The Government electrical engineers recognize this as treating a symptom rather than the disease. The procedure of the bureau's experts is, usually, first to examine into the power distribution system to see whether it is arranged to the best advantage. The next step is to examine rails to see if joints are made in such a way as to furnish a good conductor for return currents. The third step is the designing of an adequate "negative feeder" system.

The negative feeder system consists of insulated copper wires connected with the rails at various points throughout the network of tracks, furnishing a return path which is a better conductor for the current than pipes or rails. By connecting this feeder to the rails at various points with properly adjusted resistance, the differences in potential, which cause the return currents to leave the rails, can be kept very low. Though such a system does not entirely eliminate leakage of electricity, it reduces the escaping currents to such an extent that they cause practically no loss either to the railway or to the pipe owners.

Radio Telephone on Railroad Trains

By Frank C. Perkins.

SOME interesting experiments have recently been conducted on a western railroad system in the way of communication between trains, and between stations and trains, by radio telegraph, radio telephone and by wire. The experimental work has been in charge of Dr. Frederick Millener and for the greater part the experiments have been made of iron and steel. The course of the truck was on a narrow-gauge track which ran through the shop yards of the railroad. An antenna mounted on the truck was connected with a set of receiving instruments, including a special controlling device. It was found on trial that the car could be caused to move backward and forward at four different



Experimental Wireless Telephone Set of Dr. Frederick Millener, Who is in Charge of the Wireless Equipment Used by the Union Pacific Railroad.

made with a view to furnishing a means of signaling the cab of a locomotive or communicating with a train without interfering in any manner or placing any obstruction along the right of way.

In the early experiments, a storage battery electric truck was utilized. The machine weighed 5500 pounds and was speeds at the will of the operator handling the key of the wireless transmitter. No attempt was made to establish a good ground connection, as the mass of metal in the car itself provided a capacity ground which amply sufficed for the purpose.

It is generally conceded that a railroad

signal to be of practical value must operate at least 100,000 times without a failure and furthermore must not be affected by any other than the means intended.

Antenna and House Used by Dr. Millener in Conducting His Wireless Experiments. In the Oval: A Multiple Microphone and the Induction Coils Used in Dr. Millener's Wireless Telephone System.

In this connection, the experiments on the truck proved the plan to be impracticable, as it was found that at times the lighting of an arc lamp or atmospheric disturbances would throw the signal. The unreliability of the entire system, therefore, resulted in the discontinuance of the experiments.

Following these fruitless experiments, the attention of the investigators was next directed to radio telegraphic and telephonic communication between a moving train and a central station. The net result of these experiments was the installation of a special telephone system which combines many features of both radio and wire telephony. The system consists of an intercommunicating telephone from car to car and a long-distance wire telephone when the train is stopped at a station; and when the train is in motion between the stations, a wireless telephone by means of which it is possible to talk to the train ahead, the train behind, or the nearest station. The device is so arranged that while talking

from car to car it provides selective talking and selective signaling facilities. While talking long distance by wire, only one person can talk from the train at a time and the train is connected to the city trunks.

FIELD TELEPHONE ACTS AS WIRELESS RECEIVER

A curious wireless vagary occurred at the Military Training Camp in Toronto, Canada, on March 19th, during the artillery practice while observers on the top of the "chutes" were communicating by field telephone with the battery commander. The insulated wire of the field telephone was strung from the top of the structure to the ground, there being probably 200 feet or more of wire suspended in the air. While receiving messages from the observation point the signaler noticed a buzzing sound on the wire, which he supposed was caused by the buzzer used on the telephone when it is desired to use the apparatus as a telegraph instrument. On having his attention called to this, Capt. S. D. Dunn, divisional signaling officer, listened to the buzzing, and in the interval between the telephone messages caught portions of messages relating to the question of neutrality and matters connected with shipping. Capt. Dunn, who has had long experience in telegraphic work of every kind, recognized the message as part of a press despatch. Owing to the fact that the telephone was in use for artillery purposes he was not able to read the message clearly. The explanation given by Capt. Dunn was that the wire of the telephone acted as an aerial, and by some chance the telephone was "in tune" to receive the wireless waves. He thought the message was probably coming from Buffalo, where one of the papers makes use of wireless communications.

There will be more wireless in the July issue than in any previous issue. Many special features in the form of constructional articles will be included, among them an article describing the making of a multiple tuner.

The Steel Towers of the Aerial of the Chelsea Station, and the Wireless Station Building.

THE NEW GOVERNMENT STATION AT CHELSEA, MASS.

In the accompanying view are shown the steel towers of the high powered radio station situated on the grounds of the U. S. Naval Hospital at Chelsea, Mass. This station is one of the links of the chain of radio stations that extends to Panama along the Atlantic Coast and from there to the Philippines.

Each tower of the Chelsea station is 300 feet high. They are set over 600 feet apart on concrete foundations that are over ten feet deep.

There are two one-story buildings formerly used by the hospital, situated near the towers. These will serve for the receiving and generating rooms, as well as for accommodating the operators of the station. The station will probably be rated between 50 and 75 kilowatts although it is not certain at the present writing.

A NEW HIGH SPEED INTERRUPTER

The platinum break is without doubt the most simple and reliable for medium sized spark coils. Its main fault is the slow speed at which it works, usually from 25 to 35 breaks per second. The interrupter described in the following gives a much higher rate of interruptance and a comparatively long duration of contact. The latter feature is of great importance in wireless work, while the higher speed is essential for X-Ray purposes in order to obtain a clear and steady image on the screen.

The main parts of the rapid break illustrated in the accompanying drawings are:

Part *A*—A pillar carrying parts *B* and *C* which are adjustment screws.

Part *D*—A flat spring supported by part *E* which is a short length of fibre shaped as shown in the sketch on the facing page.

The spring, part *D*, carries a platinum contact piece and a soft iron hammer, part *G*, on its upper end. On the lower end of the strip a small disc of fibre is glued on in order to insulate parts *C* and *D* from each other.

The lower adjusting screw, part *C*, presses the contact piece of the spring against the contact piece on the adjusting screw part *B*. The current flows from the battery through the primary winding of the induction coil into the pillar part *A*, through the contact pieces into the spring and from there through a flexible cable soldered to the spring and back to the battery.

The core of the coil becomes magnetized, attracts the hammer and breaks the circuit. Immediately the contact pieces are pressed together again since the tension in the spring tends to make contact. This tension may be regulated by adjusting screw part *C*.

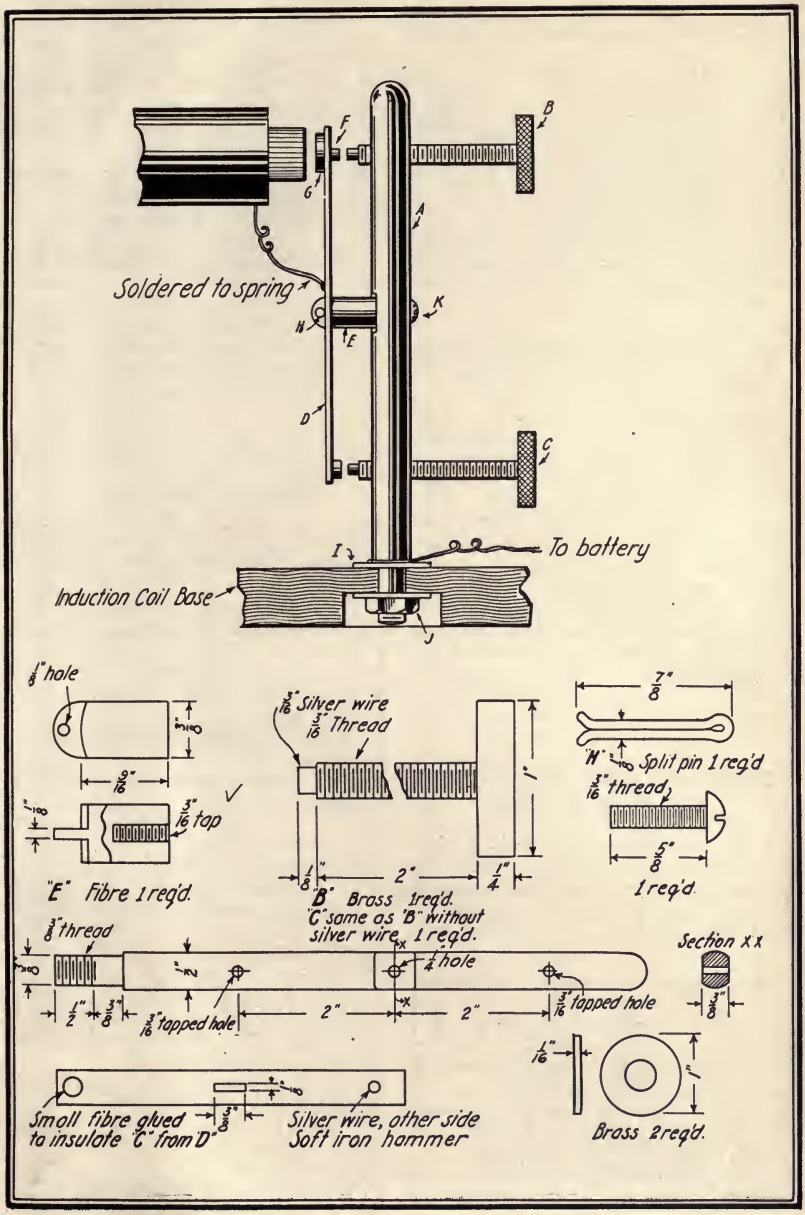
The break is very easily made, the only tools necessary being a few taps and dies and a drill, possessed by most amateurs. The spring may be either of bronze or steel, but the author believes that the latter is better by far. Inasmuch as platinum is expensive at the present time, silver may be used for the contact pieces. It is much better to have ample and clean silver contacts than small and badly fused platinum ones. Part *H* is a standard split pin to keep the flat spring in its proper place. Part *I* is a brass washer for the pillar and part *J* is a standard ⅜-inch nut.—C. A. Oldroyd.

INTERESTING EXPERIMENTS WITH ATMOSPHERIC ELECTRICITY

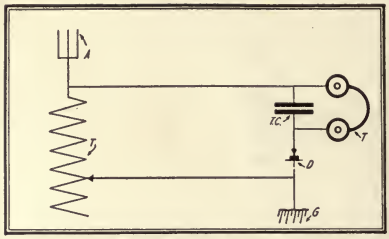
The author has conducted a series of experiments in connection with atmospheric electricity, using his aerial, which is 60 feet high at one end and 70 feet at the other, and composed of two wires 190 feet long, mounted on 7½-foot spreaders. The lead-in is from the higher end of the aerial and measures 120 feet long.

During snowstorms the author has succeeded in obtaining sparks up to three-eighths of an inch long between the lead-in and the ground. The length of the sparks increased with the strength of the wind and the amount of snow falling. A few times during clear weather, sparks up to one-fourth of an inch have been obtained for short intervals. When the secondary of a ½-inch spark coil has been connected in series with the aerial spark gap and the ground, every time a spark would leap the gap a 2½ volt lamp connected across the primary would flash.

The rate at which the sparks jump across the gap depends on the length of the gap. During a severe snowstorm sparks have jumped a ⅜-inch gap at the rate of one per second.—Ben Graber.



Assembled View of the High Speed Interrupter, As Well As Its Parts.



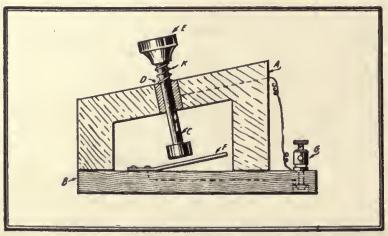
An Effective Hook-Up for Use in Connection with a Single Slide Tuner and Crystal Detector.

AN EFFICIENT SINGLE SLIDE HOOK-UP FOR BEGINNERS

Although single slide tuners have come into disfavor among most amateurs, these simple instruments, in connection with a crystal detector, condenser and telephone, comprise an outfit that will be found more efficient in many cases than a two-slide tuner. For best results, the hook-up in the accompanying diagram should be followed. The greatest advantages of a single slide tuner are the simplicity of operation and the small chance of imperfect contact and consequent weak signals.—CHARLES E. DAVIS.

A FOOT-OPERATED PUSH BUTTON FOR TEST BUZZER

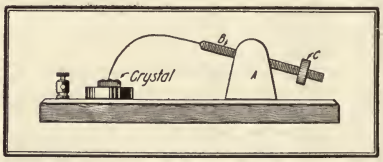
It is often found inconvenient when adjusting a crystal detector such as that of the galena type to push with one hand the button or switch controlling the buzzer circuit. In order to allow the freedom of both hands for adjusting the apparatus yet still be able to operate the buzzer when desired, a switch arrangement that may be operated by the pressure of the foot is illustrated in the accompanying drawing. This device consists of a wooden block, *A*, measuring 2 by 1⅛ by 2 inches, another block, *B*, measuring 2½ by ¼ by 2 inches which is used for the base, a metal pin, *C*, which is threaded at one end and fitted with the composition knob *E*, a spring on the pin *C* shown at *K*, a metal strip *F* and the binding posts *G*. The construction of the push button can readily be followed by studying the drawing.—R. C. ROBINSON.



A Foot-Operated Push Button That May Be Used to Good Advantage with a Test Buzzer.

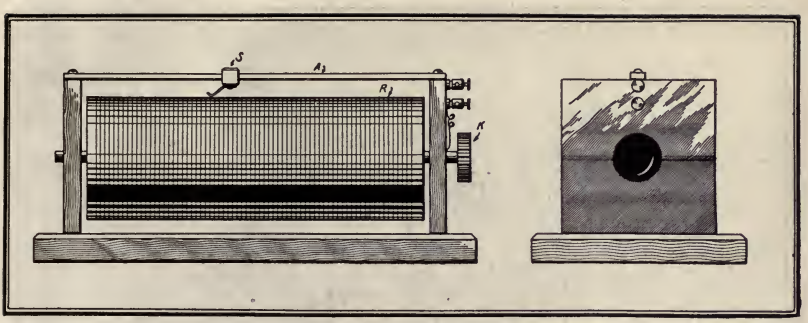
A SIMPLE YET EFFICIENT GALENA DETECTOR

The detector illustrated in the accompanying illustration, while easily constructed, will be found extremely sensitive when used in connection with galena. Most galena detectors have a coiled spring for making contact and the changes in temperature are apt to affect the spring and consequently alter the adjustment. In the detector illustrated, however, the curved wire is not affected.



A Galena Detector That Can Readily Be Made from Odds and Ends.

The main features of the detector that are different from other types are the two pieces side by side, *A*, about 1½ inches apart and between which passes a brass rod *B* pivoted by a cross rod to the two side pieces. The rod *B* is so mounted that it can be freely swung up and down. The small weight *C* which is screwed on the threaded end of the rod *B* can be moved back and forth to alter the pressure of the phosphor bronze wire on the crystal.—EMERSON SMITH.



An Improved Type of Tuning Coil in Which the Cylinder Is Mounted on Shafts to Permit of the Slider Making Contact with Any Portion of a Turn.

A NEW IDEA IN TUNING COIL DESIGN.

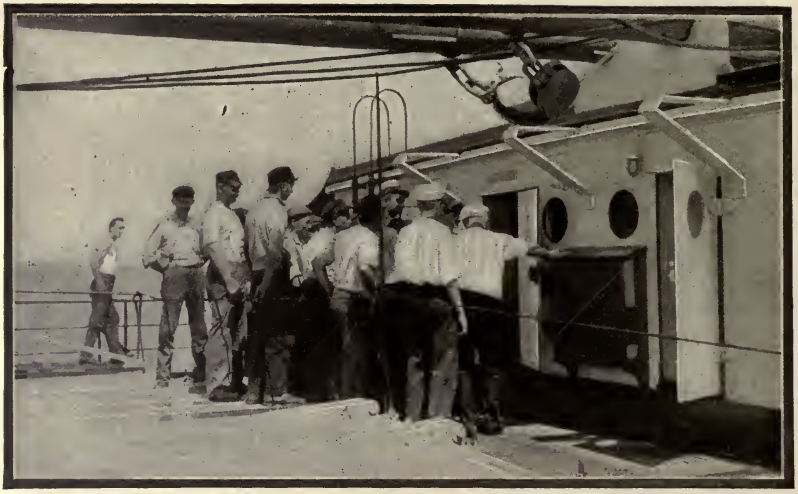
IN the accompanying illustration is shown a type of tuning coil that has been constructed and used by the author with unusually good results. The main and striking feature of this coil is that in operation the slider is moved back and forth until a signal is heard as loud as possible, and the tuning coil proper, which is mounted on shafts so as to revolve, is turned in either direction to make the signals louder still. It is immediately obvious that with a tuning coil of this type it is possible to tune accurately for the reason that any portion of a turn can be cut in.

The tuning coil is made as follows:

A base of hard wood is finished to measure 15 by 5 by ¾ inches. Its edges are beveled and the surface given a coat of paint of any color desired. The next step is to make two end pieces measuring 4½ by 5 by 1 inch. The tuning coil core is made from a common rolling pin *R* from which the handles have been removed. At one end of the cylinder is placed a metal or wooden rod to act as an axle. At the other end is provided a metal rod fitted with a suitable handle. The cylinder is then given a coat of shellac and, when it is almost dry, it is covered with turns of No. 24 bare copper wire. In winding on the wire the builder should be careful not to let the various turns touch, although they should be placed as close together as possible. One end of the wire is tacked fast, while the other is soldered to the brass rod which mounts the handle. Holes are bored in the end pieces to allow the cylinder to turn when placed in position. In one of these end pieces a brass tube of a size to permit the brass rod of the cylinder to pass is placed in the holes so as to allow the cylinder to turn freely. This brass bushing is connected to one of the binding posts on the end piece by means of a short length of wire. The next step is to secure a square ¼-inch brass rod, *A*, an inch longer than the wooden cylinder, as well as a regular tuning coil slider, *S*. The rod is placed in position and the slider mounted so that it will freely slide back and forth. Connection with the remaining post is made by means of a short length of wire from the slider.

The use of a tuning coil of this type will serve to make the use of a condenser unnecessary, since accurate tuning can be accomplished with the inductance alone.—F. H. Fitch.

The July issue will contain more wireless articles than any previous number. One of the features will be a description in detail of a multiple tuner receiving set.



During War Time the Wireless Station on Board a Steamer Is the Center of Attraction for the Crew. The Men Gather About the Door of the Wireless Cabin Waiting to Hear the Latest Reports of the Fighting.

THE WIRELESS ROOM IN WAR-TIME

In the present war, whether a battleship is under fire or is cruising peacefully in the open sea, the wireless room is the liveliest place on board. Messages, whether for that particular ship or not, must be copied and handed over to the captain. The war office is sending orders almost continuously, and these must be copied *verbatim*—a most arduous task, for the reason that all orders are transmitted in a secret code and one letter or figure wrong might change the meaning of the entire despatch. If the ship is one of a fleet, the operator must be alert constantly for war orders from the admiral.

The operator is stationed behind closed doors, so that the noise of the heavy guns will not interfere with the reception of messages. He is in momentary danger of quick death from foes who are apt to attack by sea, by submarine and by air.

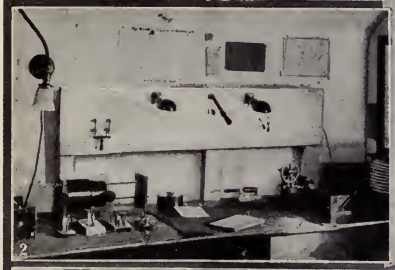
THE WIRELESS ASSOCIATION OF PENNSYLVANIA

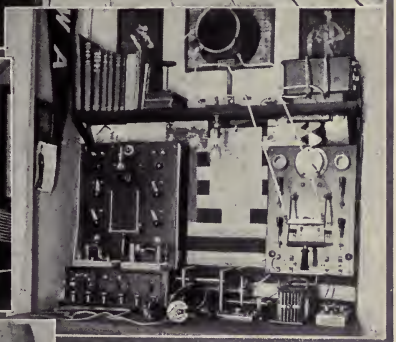
It is announced by the Wireless Association of Pennsylvania that the board of directors for 1915 consists of F. B. Chambers, chairman; W. Holzbaur, L. M. Knoll, H. W. Denshan, C. A. Service, R. E. Peterson, W. N. Reiff and the officers.

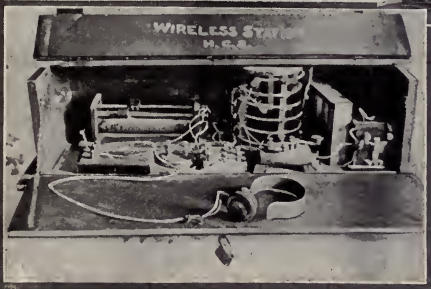
This association has confined itself mostly to Philadelphia and immediate vicinity in the past. However, it now expects to extensively enlarge its territory. At a recent meeting of the Publicity and Organization Committee, the Secretary was instructed to request all organizations in Pennsylvania to communicate with the Wireless Association of Pennsylvania with the idea in mind of forming a state-wide association.

Watch out for the Radio Section in the July issue of THE WORLD'S ADVANCE!

AMATEUR WIRELESS STATIONS





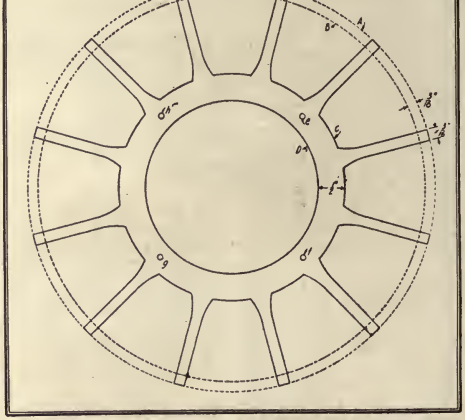


(1) Wireless Station and Laboratory of Stephen E. Horton, of Pasadena, Cal. This Experimenter Has a Set of High Frequency Instruments, Shown In the View. (2) Sending and Receiving Apparatus of George O. Forrest, Kansas City, Mo. (3) Portable Wireless Outfit of Henry C. Sauyer, Astoria, N. Y. (4) Wireless Station of Antone Sylvia of New Bedford, Mass.

A SIMPLE AND EFFICIENT ROTARY GAP DISC

ALUMINUM and aluminum alloys are now being extensively employed in the construction of commercial spark gaps. The method of construction followed by the amateur when making an aluminum disc is to cut out "saw-teeth" around a thick disc of the metal. Those who have tried this know what a job it is; for aluminum, though light, is very difficult to work. The ease of construction of the disc herein described will appeal to the experienced ones, and if followed by the novice will save much labor and patience.

First secure a piece of hard aluminum sheeting 1/32" thick. With a compass or dividers carefully measure and mark out the piece as shown in the diagram. The disc should be 8" in diameter to be most efficient (as was pointed out by E. E. Bucher in the March issue of *Modern Mechanics*). Twelve electrodes is the practical number for a motor having a speed of 2500 to 3000 R. P. M. If the motor is faster than this, 8 or 10 will do; if slower, increase the number to, say, 16. Now cut around the blades with tin shears. Do not cut the parts to be cut on circle C with tin shears. The latter are too unwieldy and would bend the metal out of shape. Instead, cut these places half way through with a chisel, then bend the pieces out. Now center a disc of 3/32" fibre, the size of circle *C*, on the aluminum disc, and mark four places for the holes *e*, *f*, *g* and *h*. Bore the holes for small machine bolts. The center of the aluminum disc (circle *D*) may then be cut out. Bolt the aluminum to the fibre. Now bend back the tips of the blades on the dotted lines, at right angles to the blades. It will be noticed from the dimensions in the diagram that these tips afford an ample sparking surface 3/16" square. The disc is now ready to attach to the motor shaft. This is done in the regular way, either by bolting to a pulley wheel or fastening in an emery wheel clamp found on some motors.

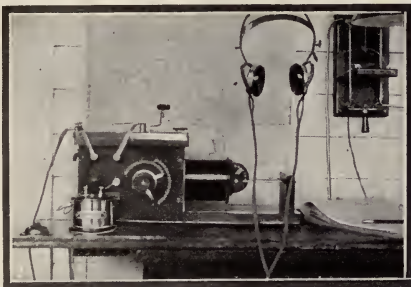


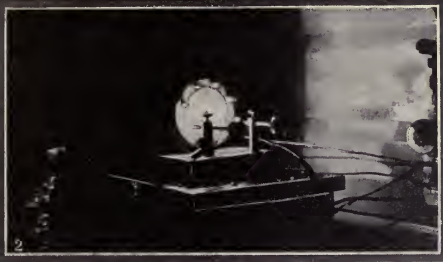
Pattern for Aluminum Disc, Showing the Location of the Screw Holes and the Shape and Size of the Arms.

After the disc is assembled twist the blades so that they have a pitch of about 15 degrees. Twist them in such a way that the tips turn away from the direction of rotation. Pitching the blades in this manner serves three very important purposes. First: By carefully adjusting the degree of pitch the speed may be permanently fixed at which the spark-note is most resonant. (The greater the pitch the slower the speed.) Second: The fan effect of the blades draws air through the motor, thereby cooling it. Third: The air resistance against the pitched blades, when the motor is running, gives the motor a slight load, which keeps it from "racing" as it would otherwise do with such a light disc. No. 6 aluminum wire, or 3/16" aluminum rod, makes good stationary electrodes.

Some persons may be skeptical about the wearing qualities of this disc. The writer has one which has been in regular use on a ¼ k. w. transformer for five months and at present shows no appreciable signs of wearing out. In case any of

AMATEUR WIRELESS STATIONS





THE WIRELESS STATIONS APPEARING IN THE VIEWS ARE:

(1), (2) and (5)—Various Views of the Wireless Station of Raymond Myers, of Tiffin, O. In the First View Is Seen His Navy Type Receiving Transformer, Fixed and Variable Condensers, Galena Detector, Telephone Head Set and Aerial Switch. The Second View Shows His Rotary Spark Gap in Operation, While in the Third View Is Seen the Complete Transmitting Set, Which Is Rated at ¼ KW. (3)—The ½ KW. Wireless Station of Palmer Leberman, of Sheboygan, Wis. (4)—The Two Wireless Sets of Arthur C. Stansfield, of Lawrence, Mass. Practically All the Instruments Were Made by the Owner of the Station.

the tips do wear off after long use, cut them all off even at the place where they were bent and bend new ones. This may be done several times, providing the disc is made large enough at the outset.

This disc, aside from having so many advantages, is also efficient. The efficiency lies in the fact that aluminum is the metal used. Those who get a ragged spark with zinc or brass electrodes will secure a pure note with aluminum. The reason for this is that zinc and brass will warm up a slightly defective condenser, thereby causing it to buckle. No such effect is noticed when aluminum is used.

GEORGE H. BRINKERHOFF.

TO ERECT LONGEST WIRELESS SPAN IN THE WORLD

THE United States Government, through the Bureau of Yards and Docks of the Navy Department, during the month of March awarded contracts for the erection of what will be the most wonderful wireless system in the world. Spanning the Pacific Ocean it will reach from San Diego, California via Honolulu, to the Philippine Islands, a distance of more than 5,000 miles. The San Diego station will be located in the Cholas Valley, the Honolulu station in Pearl Harbor, the army and navy post, and the Philippine terminal at Cavite, overlooking Manila Bay. The Pearl Harbor and Cavite link of the system will be more than 3,000 miles in length, whereas the greatest communicating link of wireless now in existence is that across the Atlantic, slightly under 2,500 miles.

Excepting the Eiffel Tower in Paris, andwhose efficiency is comparatively small, due to the fact that it has no complement, the towers of this Pacific system are also to establish a new record for height, for they will be in the neighborhood of 600 feet high. And in every other way will this system be framed on lines of immensity

Tips for the Wireless Amateur

¶ Don't receive with the switches out. It's bad for the instruments.

¶ Don't think you are getting blank place if you accidently happen to push the buzzer test.

¶ Don't stretch the sending of your coil. You have probably stretched the spark only.

¶ Don't believe all you hear. If someone says he can receive 2,500 miles, take the square root of it and then divide by two to find his true radius—or ask to be shown.

¶ Don't tell a wireless yarn until you are absolutely sure that you have a greenhorn to deal with. You may need a smaller sized hat afterwards if you do.

¶ Don't hold on to the spark gap and accidentally press the key. It's bad for the coil as it short-circuits the secondary.

¶ Don't receive messages all the evening and then before you go to bed go to ground your aerial and find it is already grounded. If you do we would advise having the telephone tested since they would probably be strained.

¶ Don't try to read static. He uses a private code.

¶ Don't try to manufacture a spark coil without proper equipment. You may exhaust your vocabulary.

¶ Don't try to put up an aerial 25 feet long and expect to get blank station 500 miles away.

¶ Don't rate the voltage of your spark coil on placards. It may look well but think how many times you would have been electrocuted if the notices were true.

One Who Knows.

never before attempted, for the various stations will possess generating facilities that may be virtually compared to all others as the candle to the incandescent light.

Each station will consist of three triangular towers, set on a triangle of 1,000 feet from point to point; a power house of generating facilities comparable with that of a town of 5,000 persons, and the usual attendant quarters. With a height of 600 feet, as already stated, each tower will be 150 feet in base measurements, and will consist of 300 tons of steel, for they will be of all-steel construction. The cost will be $29,100 each for the fabricating and erecting of the San Diego towers, $30,900 each for the Pearl Harbor towers, and $34,200 each for the three towers at Cavite. The contract for the stations at San Diego and Pearl Harbor was secured by the Llewellyn Iron Works of Los Angeles, California, and the one for the towers at Cavite was awarded to the Pittsburgh-Des Moines Steel Company of Pittsburgh, Pennsylvania. A year is given in which to do the forging and erecting of the towers. The entire distance will be covered by these three stations.

THE CENTRAL RADIO ASSOCIATION

The Central Radio Association is making plans to publish a directory call book of all amateur stations known to them in twenty-four states lying between the Rocky Mountains on the west and the Ohio River on the east. All amateur operators living in this territory can have their stations listed in the book by writing to H. B. Williams, Secretary of the Central Radio Association, Chanute, Kansas. All names must not be sent in later than June 5th.

BINGHAMTON PROGRESSIVE RADIO ASSOCIATION

At a meeting of the wireless amateurs, held April 20th, 1915, in Binghamton, N. Y., the Binghamton Progressive Radio Association was formed and the following officers elected for the first term: Kenneth Kingsbury, President; Wallace Dunmore, Vice-President; Ray H. Holmes, Secretary; Mr. Bovee, Treasurer, and Mr. Hollister, Sergeant-at-Arms. Seventeen members were present at this meeting and it is said by the Secretary that every indication points to a successful year for the association. The purpose of the club is to promote good fellowship among the amateurs in Binghamton and outlying districts. An experimental department is to be established in which interesting and instructive experiments will be carried out. The club will be glad to hear from other clubs and individuals. Correspondence should be addressed to the Secretary, Ray H. Holmes, 157 Robinson street, Binghamton, N. Y.

PLANT CULTURE BY HIGH FREQUENCY CURRENT.

(*Continued from page* 835.)

lower end of the secondary cylinder. From the detailed drawing in Fig. 2 the reader will note that four posts of black fibre rod, 2¼ inches high and one inch in diameter, are given a series of saw cuts to a depth of three-eighth inch. Eight cuts will be required in each post to take the eight turns of primary strip. The cuts may be made with two blades of a hacksaw placed side by side to give the required thickness or, what is by far the better method, the cuts may be taken in a milling machine if one is available. The posts are located on the base-board and secured with short machine screws tapped into the fibre. Care should be taken to see that the screws do not pass into the posts beyond the bottom turn of the primary.

The assembly of the parts is clearly shown in Fig. 1 and it is believed that no further comment is necessary other than to say that the bottom turn of the primary is connected with the ground stud, as shown in the diagram of connections.

Wireless club notes and announcements will be published in these columns whenever received.

What the World is Doing

WHATEVER may be the political and economic effects of the European war, there is one fact that stands out prominently amid the chaos. That fact is the advancement made in chemistry as a result of the military operations. Before the war many American industries were dependent on German manufacturers for certain chemicals, and during the early days of August many organizations spent more than one sleepless night in wondering how they could keep their factory wheels going without the heretofore easily procurable German chemicals and dyes. And this very state of business gave American ingenuity and inventiveness an opportunity of asserting itself. One of the chief industries to suffer, the dyeing industry, was soon aided out of its serious predicament by the wonderful discovery of an American chemist. So it has been in many other fields, with the result that we Americans have been made an independent community and given a great opportunity of developing our resources to the utmost. Meanwhile our European brothers have experienced the same difficulties and consequential advantages. Countries other than Germany have always been more or less dependent on that nation for many of their chemicals. When the war broke out they were also confronted with the problem of making their own raw materials. It was the opportunity for the chemical engineers and inventors—and they took it. These countries, as in the instance of the United States, have become more independent than ever before. But chemistry has not rested here. It has been developed even on the battlefields. First the French and English made extensive improvements in the explosives used in their shells in order to make them more deadly. Then the Germans retaliated by releasing deadly gases that were blown by the wind over the trenches of their opponents. The effects of the gases—said to be chlorine—have been far more deadly than artillery fire. Men have been killed almost instantly by the heavy fumes, which can penetrate deep into the trenches and bomb-proofs. Now the French and British soldiers have again applied their chemical knowledge in counteracting the deadly effects of the German gas bombs and tanks. Latest reports have it that they are spraying ammonia into the air, which, on mixing with the chlorine fumes, converts the latter into harmless ammonium chloride—a soft powder which soon sinks to earth. Thus the war at its present state is a war of chemicals. It is true that the advantages derived from the war will be far outbalanced by its terrible cost. Yet is it not fortunate that at least one advantage—the development of chemistry—is accruing?

With the fast approach of summer and its thunder showers, the article entitled "Lightning Protection," by A. S. Blatterman, appearing in this issue, must necessarily prove of interest to readers of an electrical turn of mind. While the article is in truth a purely electrical one, since it deals with lightning protection on long transmission lines, still it has been included in the Radio Section for the reason that it should be read by every wireless amateur. In a great measure the information it contains will be found very valuable in effectively protecting a wireless station from the possible ravages of lightning.

The wireless telephone has at last come into its own—at least in one of its numerous fields of application. We learn that the Lackawanna Railroad in the East is using a wireless telephone equipment on one of its fast trains, and that the service is proving practicable. The range of the apparatus is being increased, and it is not a wild flight of fancy to look forward to the extensive employment of the radio telephone on all through passenger trains—and even freight trains for reasons of economy. While the Lackawanna Railroad is developing its wireless telephone service, news comes of the experiments of Dr. Millener with wireless telegraph and telephone apparatus for the Union Pacific Railroad in the Middle-West. Surely we are on the eve of a new era in wireless communication.

The rapid growth of THE WORLD'S ADVANCE has necessitated the removal of the organization from the former offices at 32 Union Square to its new home at 239 Fourth Avenue, New York, where it occupies the entire twelfth floor.

Short Circuits

Teacher—Now, Willie, mention one of the customs at Christmas time?

Pupil—Running in debt.—*Life.*

Willie—Paw, why is the way of the transgressor hard?

Paw—Because so many people have tramped on it, my son.—*Cincinnati Enquirer.*

"I think if I were a Tommy Atkins going to France, I'd join the bicycle corps."

"Why so?"

"Then, if I got homesick, I could puncture a tire and once again breathe my native air."—*Boston Transcript.*

"I'm not at home to that gentleman, Jane," declared the belle.

"You haven't seen his card, yet," protested mother. "You don't know who it is."

"True; but it isn't the machine I am waiting for. I can tell by the honk."—*Louisville Courier-Journal.*

"What could have brought you to this, my poor man? You appear to have seen better days."

"Yes, I was once an author, madam. I lost all I owned trying to find a publisher for my last book, on 'A Hundred Ways to Get Rich.' "—*Follia.*

Teacher—Now, who can tell me which travels fastest—heat or cold?

Johnny Bright—Heat, of course; anybody can catch cold.—*Selected.*

Mr. Henpeck—Is my wife going out?

Jane—Yessir.

Mr. Henpeck—Do you know if I am going with her?—*London Tatler.*

"Coal and diamonds are really made of the same substance."

"Well," replied the young woman who typewrites, "I'll take the diamond. I don't care for the carbon copy."—*Washington Star.*

The Applicant—There's lots of push and go in me. I'd like to show you.

The Boss—Very well. That door opens outward. Try your push on that and then demonstrate your go on the outside.—*Chicago News.*

Teacher—Jane, can you tell me who succeeded Edward VI.?

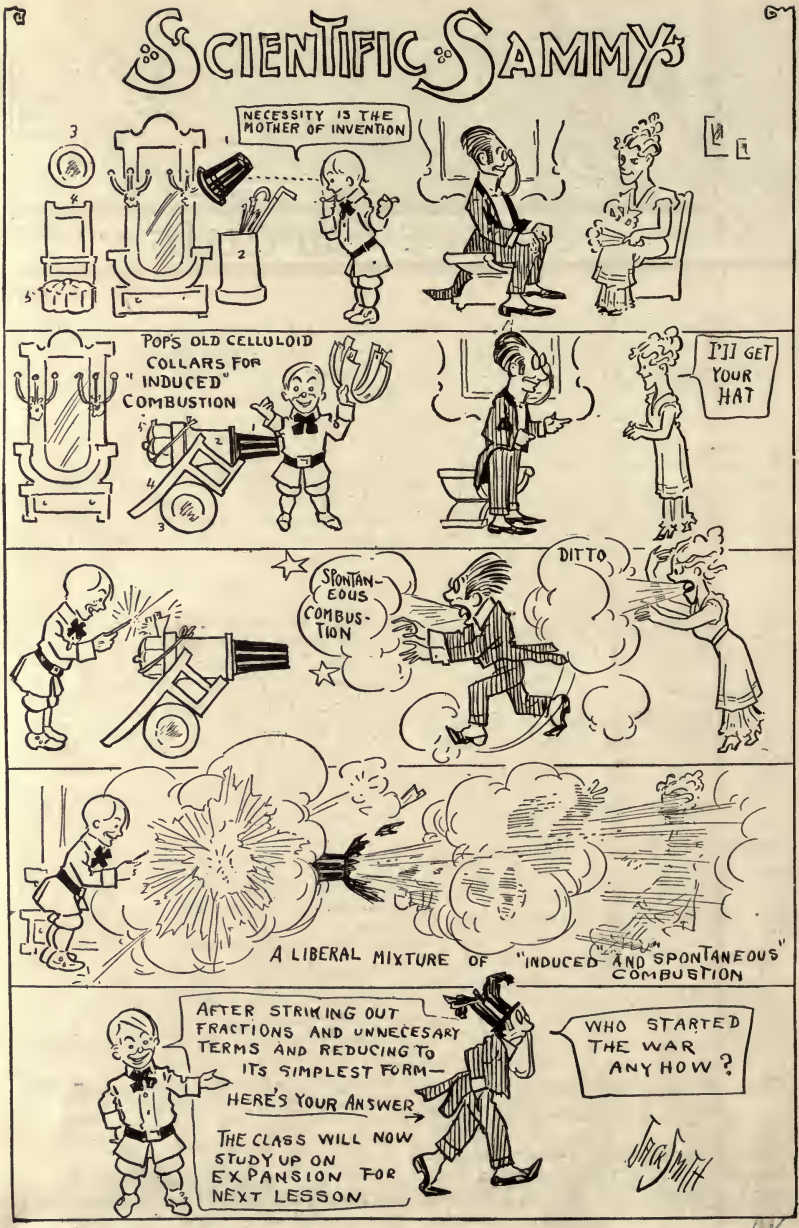
Jane—Mary.

Teacher—Now, Lucy, who followed Mary?

Lucy (absent mindedly)—Her little lamb.—*Theosophical Path.*

"Have you a circulating library?"

"No ma'am; but I can show you some nice revolving bookcases."—*Judge.*


SCIENTIFIC SAMMY'S
NECESSITY IS THE MOTHER OF INVENTION
POP'S OLD CELLULOID COLLARS FOR "INDUCED" COMBUSTION
I'LL GET YOUR HAT
SPONTANEOUS COMBUSTION
DITTO
A LIBERAL MIXTURE OF "INDUCED" AND SPONTANEOUS" COMBUSTION
AFTER STRIKING OUT FRACTIONS AND UNNECESARY TERMS AND REDUCING TO ITS SIMPLEST FORM—
HERE'S YOUR ANSWER
THE CLASS WILL NOW STUDY UP ON EXPANSION FOR NEXT LESSON
WHO STARTED THE WAR ANY HOW?
Jno Smith